Nature Magazine

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1954

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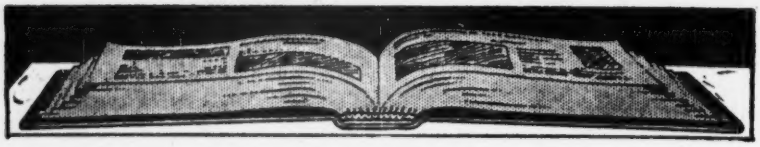

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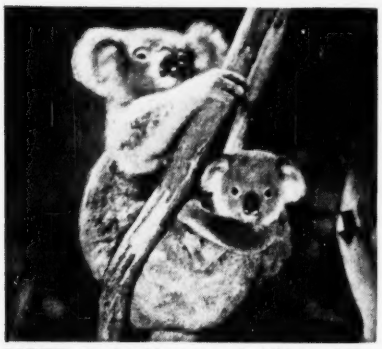

MEET the lovable, unusual children of Nature, like the shy, tree-dwelling baby Koala, who was the model for the original "Teddy bear." You'll learn about the "cubs" and "fledglings" of forest and stream—how they are born and reared, how they learn to fly, swim and hunt.

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This revolutionary "Museum-at-Home" program, sponsored by the National Audubon Society, has captured the imagination of thousands of families. With the aid of magnificent color photographs—and fact-filled albums in which to mount them—you journey each month "into the field" on a rewarding quest after Nature's secrets.

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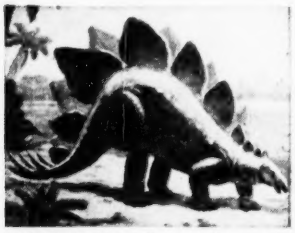

LEARN about the creatures who roamed the land and swam the seas millions of years ago—like the Stegosaurus, 15 feet of armor-plated might, but with a brain no larger than a walnut!

Fascinating "things-to-know" and "things-to-do"

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You see how Nature "protects her own" with ingenious camouflage. . .discover how Nature's wonders inspired many of man's inventions. . .follow the migrations of sea birds across the wide oceans . . .learn the strange, almost unbelievable ways in which some animals reproduce, and rear their young. *Best of all, your naturalist-guides will open your eyes to the wonders you can discover in your own backyard or park!*

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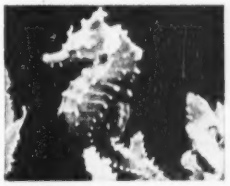

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Nature in Print

Vacation and intensive field activity for The Wilderness Society, of which he is the executive secretary, have combined to prevent Howard Zahniser from supplying his usual article this month. He will be back with us in the December issue.

Nature Recreation

Nature Recreation. By William Gould Vinal. Boston. 1954. American Humane Education Society. 322 pages. Illustrated. $3.50.

First published in 1940, this book, which bears the sub-title "Group Guidance for the Out-of-Doors," has for some time been out of print, but is now, happily, once more available thanks to the American Humane Education Society. This is a book that is really essential for the library of anyone engaged in Nature leadership work. It is full of both inspiration and practical suggestion that the author has gathered through a lifetime devoted to Nature education as a teacher and practitioner. Our copy contains, on its title page, an inscription that reads: "To Dick Westwood—from one old timer to another. May our trails X oftener, and may the sun always shine for you. Cap'n Bill." We shall specially treasure this copy for this inscription. R.W.W.

Crater Lake

Along Crater Lake Highways. By George C. Ruhle. Crater Lake National Park, Oregon. 1954. Crater Lake Natural History Association. 58 pages. Illustrated. $1.00

This road guide to Crater Lake National Park is written by the former Park Naturalist there, who is now the naturalist at Hawaii National Park. This guide is designed to aid those who have limited time at Crater Lake but who wish to see and understand its significant features. Having been at this Park for eleven years, Dr. Ruhle knows well how to get the most out of it, and anyone planning to go to Crater Lake should first provide himself with this booklet, which will slip easily into the pocket.

For Leaders

Group Fun. By Catherine Conway Reiley. New York. 1954. Dodd, Mead and Company. 342 pages. Illustrated by Margaret E. Dieckerhoff. $3.95.

This is an immensely practical and useful book that will be welcomed by all leaders of activities for girls. It presents techniques for leaders, and includes games and other activities for girl groups. It is brought out in recognition of the great increase during the past fifteen years in the membership of young people in community and camp groups. The result has been, of course, that many lay people have been pressed into service as leaders and they have needed some such practical source as this to aid them in fulfilling their responsibility. The first section of the book is devoted to leadership; the second to the value of games and other activities; the third to clubroom activities; the fourth to outdoor activities; the fifth to camping activities. There are also chapters on outdoor and camp cookery, and on camping, plus a fine bibliography.

World of the Cactus

The Giant Cactus Forest and Its World. By Paul Griswold Howes. 1954. New York: Duell, Sloan and Pearce; Boston: Little, Brown and Co. 258 pages. Illustrated. $7.50.

The giant cactus forest of the Southwest is the setting for this book, which is equally concerned with the birds, mammals, insects, reptiles and plants associated with these great saguaros. There exists in this cactus forest a biotic association of superior interest. Before undertaking his study, the author, with Mrs. Howes, consulted the literature, but found that there was nothing that treated with the world of the giant cactus in its intricate and fascinating entirety. This lack dictated the plan for this book. Curator of the Bruce Museum at Greenwich, Connecticut, a widely traveled naturalist and an accomplished photographer, Dr. Howes was outstandingly equipped for the task he set himself. In that task he has succeeded notably, providing a volume that is both delightful reading and a wide source of information. There are 186 photographs, one color plate, and field sketches and diagrams to round out the story of the saguaro world as he found it.

New Library Journal

Junior Libraries is the title of a new monthly publication starting with its September, 1954, issue and published by the *Library Journal.* It is devoted to articles on developments in library work with children and young people and to reviews of children's books. Gertrude Wolff, 52 West 45th St., New York 36, New York, is editor, and it goes to regular subscribers to *Library Journal,* and to others at a rate of $2.50 a year.

Insect Homes

Insects and the Homes They Build. By Dorothy Sterling. New York. 1954. Doubleday and Company. 125 pages. Photographs by Myron Ehrenberg. $2.50.

Insect homes are fascinating in their variety and often remarkable in their ingenuity and architecture. Many of them are to be seen by anyone who goes outdoors but more often than not these homes are overlooked. This book should stimulate the watchful eye and thus introduce many people to a most interesting subject.

Use of Lands

Word came to us, too late for an advance announcement, of the inclusion in the curriculum at the Edith Macy Training School, Pleasantville, New York, of a special course on the use of large and small tracts of land. This school is the national Girl Scout adult education center. Marie Gaudette of the national staff is in charge of the course, and says that the theory of land management presented can be applied to backyard landscaping as well as to larger stretches of land. From time to time we have been asked by those in charge of Girl Scout camps, and others, for advice on the management of areas for conservation and conservation education. This course should be of great assistance in answering such questions.

Briefly Noted

Thoreau. By William Condry. New York. 1954. Philosophical Library. 111 pages. $3.50. An appreciation of Thoreau and a biography of his life by a British naturalist and honorary member of the Thoreau Society of America.

The Duck Hunter's Manual. By Bob Kennedy. New York. 1954. Hanover House. 96 pages. Illustrated by Frank C. Jahn. A spiral-bound, pocket book on identification and the mechanics of duck hunting, with a special appeal for conservation.

W. H. Hudson. By Ruth Tomalin. New York. 1954. Philosophical Library. 143 pages. A biography of the famous naturalist-writer, born of New England parents in the Argentine and an adopted son of England.

Directory of Hydrobiological Laboratories and Personnel in North America. By Robert W. Hiatt. Honolulu, Hawaii. 1954. University of Hawaii Press. 321 pages. Illustrated. $3.75. The title indicates the scope of this book, which was prepared under the auspices of the Advisory Committee on Hydrobiology to the Office of Naval Research.

The Recreation Program. Chicago. 1954. The Athletic Institute. 342 pages. Illustrated. $3.00. A report based upon a national conference workshop of forty experts in the various areas of recreation, including an excellent section on outdoor recreation that uses the natural environment for recreation.

Wander and Watch. By Walter J. C. Murray and L. Hugh Newman. New York. 1954. Staples Press. 195 pages. Illustrated. $2.50. Two British writer-naturalists collaborate to describe what you can see in Britain when you wander and watch, a sequel to an earlier book describing what can be seen when you stand and stare.

The Tigers of Trengganu. By A. Locke. New York. 1954. Charles Scribner's Sons. 191 pages. Illustrated. $3.50. Stories of tigers and tiger hunting in remote northeastern Malaya.

Among the Seals

A Seal's World. By Frank Stuart. New York. 1954. McGraw-Hill Book Company. 224 pages. Illustrated by Walter Ferguson. $4.00.

This is the story of a harp seal during the first three years of its precarious existence and its adventures in the frozen northern seas that provide its habitat. Mr. Stuart writes beautifully about Nature, and imaginatively, too, although his imagination now and then got the upper hand in his earlier and popular *City of the Bees*. In his preface to this immediate book the author points out that it is not intended as a work of zoology but is, rather, an adventure story. It is that, and an exciting one, also. As background for his re-creation of the life of the harp seal Mr. Stuart has done extensive research and has had the cooperation of Dr. Erling Sivertsen of Norway, probably the world's leading authority on the biology of this seal.

Bulletins

"Soil Conservation Pays Off" is the title of Bulletin 575 of the University of Illinois Agricultural Experiment Station and is published in cooperation with the U. S. Soil Conservation Service. Written by E. L. Sauer and H. C. M. Case, it presents the results of ten years of conservation farming in Illinois. . ."Use of Impounded Water for Fish Culture" is Research Report #35 of the United States Fish and Wildlife Service. It is the work of Harlan E. Johnson and Richard F. Brice. Copies are available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for twenty cents. . ."Littleleaf Disease of Shortleaf and Loblolly Pines," by W. A. Campbell and Otis L. Copeland, Jr., is Circular #940 of the U. S. Department of Agriculture, and available from the Superintendent of Documents for twenty-five cents. . ."The Discovery of Unicellular Life" is a booklet containing excerpts from the *Collected Letters of Antoni van Leeuwenhoek* and is available from The Chronica Botanica Company, Waltham 54, Massachusetts, publishers of the *Collected Letters* in two volumes.

In the Garden

Garden Friends and Foes. By Richard Headstrom. New York. 1954. Ivey Washburn. 219 pages. $3.50.

Anyone who has gardened well knows that there are risks involved, dangers to that which he is growing and frequent frustrations. The garden must exist and prosper, or not, in relation to birds, insects, mammals and reptiles, some of these friends and some of them foes, as well as with relation to plant diseases and weeds. In this practical book the author seeks to aid the gardener in wooing the friends and controlling or eliminating the foes of his garden labors. He gives us a most useful book.

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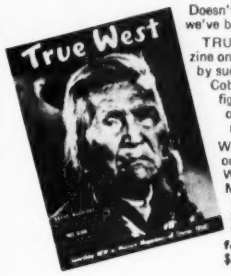

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"**Stars** is by far the best guide to the constellations in existence."—David Dietz, *Science Editor, Scripps-Howard Papers*

"Surely there has never been a better book on **Insects** at the price."—E. S. Thomas, *Ohio State Museum*

"**Flowers** is a wonderfully helpful aid to beginners."—Farida Wiley, *American Museum of Natural History.*

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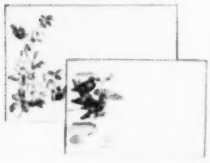

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To Stimulate Public Interest in Every Phase of Nature and the Out-Of-Doors, and Devoted to the Practical Conservation of the Great Natural Resources of America

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Contents Noted

EXAMPLES of how easy it is for legislation dangerous to conservation of our natural resources to slip through are found in the Atomic Energy Bill, which recently kicked up such a row in the Senate, and in the Multiple Mineral Development Bill. Conservationists discovered that both pieces of legislation contained provisions that would have allowed issuance of leases or permits to explore for minerals on *all* public lands of the United States. Thus national parks and monuments, which have inviolate status, and wildlife refuges, were open to such invasion. A group of conservationists brought this to the attention of Senator Clinton P. Anderson of New Mexico, who introduced an unopposed amendment on the floor of the Senate. This accepted amendment provides that "notwithstanding any other provision of law such leases or permits may be issued for lands administered for national park, monument, and wildlife purposes only when the President by executive order declares that the requirements of national defense make such action necessary." Similar protection was written into the minerals bill by a Conference Committee. Eternal vigilance appears to be the price of both liberty and conservation.

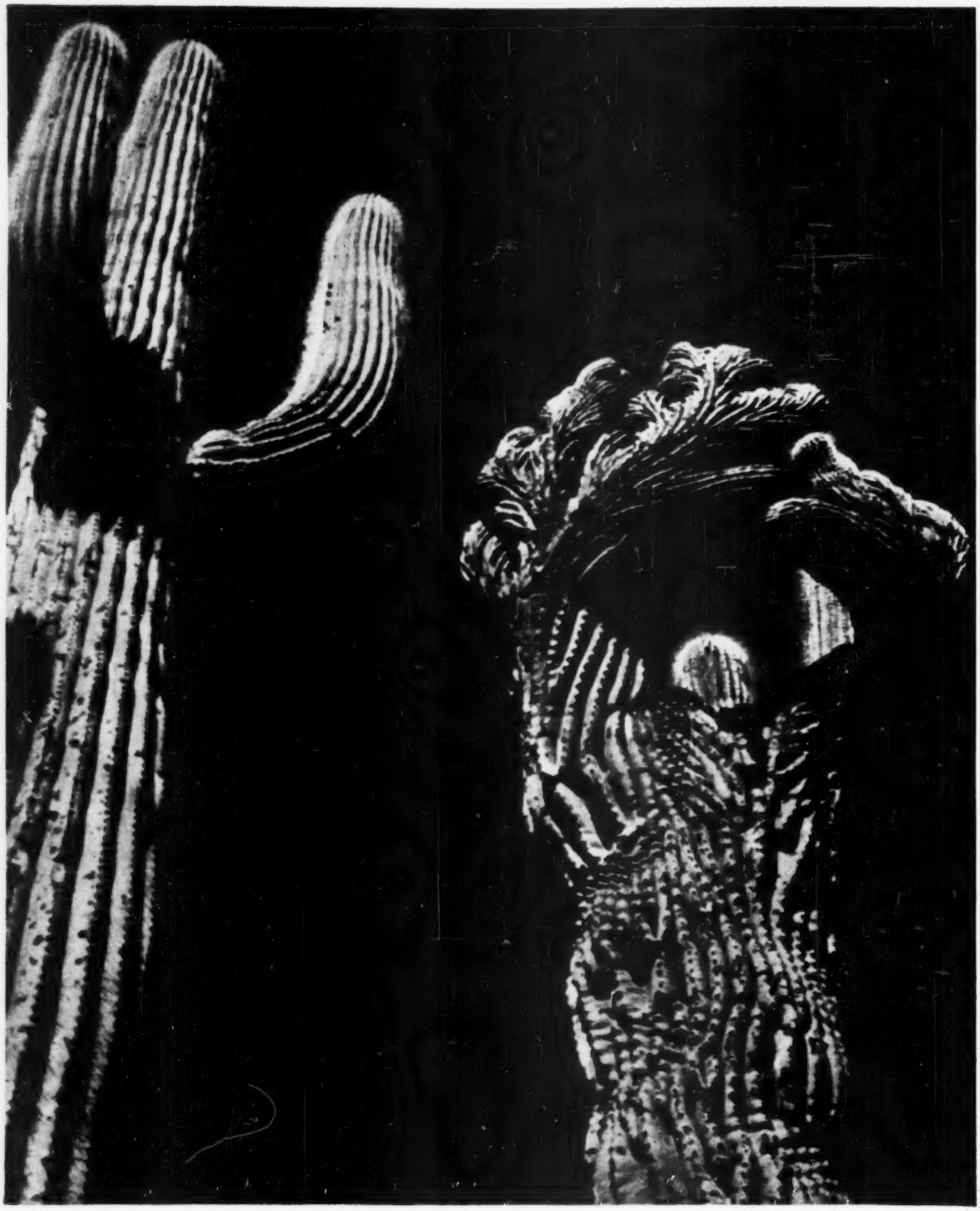
THREE brothers run Minky's Toy Shop in Chicago. They came to the conclusion that BB guns in the hands of boys are dangerous and contribute to juvenile delinquency. So the brothers decided to do something about it. They announced an offer of three-dollar gift certificates with which boys could replace their guns by acquiring other products offered by the store. The guns would then be destroyed. There is no question but that BB guns in the hands of far too many boys are dangerous to other youngsters, to public and private property, and to bird life. The Chicago brothers are to be complimented on their vision.

ON THE Cabeza Prieta Game Refuge and adjacent Organ Pipe National Monument in Arizona, the Sonora pronghorn antelope, smallest of all North American antelopes, is given complete protection. These animals require a large area of the arid and undisturbed borderlands of Mexico and southwestern Arizona for survival, according to the Wildlife Management Institute. However, developments in their habitat in Mexico have made their survival there questionable. Although not legal game across the border since 1922, the antelopes have been steadily decreasing in numbers. So their hope for continued existence appears to depend on their being given the seclusion that they require. However, during World War II the U. S. Air Force, as an emergency measure, was permitted to use the Cabeza Prieta and adjoining public lands for air-to-air gunnery practice. Now the Air Force wants primary jurisdiction over the refuge. The Wildlife Management Institute pertinently points out that: "It seems imperative that if game ranges are to perform their primary objective, all pressures, federal or private, must be made aware that refuge lands are selected, acquired and operated for a definite public purpose. It seems that certain federal agencies are viewing refuges more commonly as public land that can be confiscated or seized without purchase." It is unfortunate indeed that, today, it is unsafe to assume that areas such as wildlife refuges, national parks and similar reservations become automatically safe from those who would exploit them for private or special purposes. Conservationists must be ever alert to hold the ground gained in recent years.

ONE of the current rackets is the sale of breeding pairs of chinchillas to the unsuspecting for prices ranging up to $1500 a pair. The president of the Chinchilla Association of America declares that this is "fast becoming the nation's biggest swindle," and he points out that many of the pairs sold are not worth $25. The racketeers selling these little Andean rodents paint vivid pictures of tremendous demand for extremely expensive women's coats made of chinchilla fur. Yet people in the fur industry will not venture a guess as to the future of chinchilla fur, since the furs are not on the market, and there has been no proved demand for garments made from them. Better Business Bureaus are aroused by this racket, also, principally because it is doing people out of considerable sums of money. Chinchillas can, of course, be raised, and are being successfully raised. But the average individual does not have the know-how or the facilities to undertake such a business, and fur-farming is a highly specialized and tricky undertaking. Whatever the future of the chinchilla's fur may be, nobody should attempt to go into the business of propagating the little animals until they have studied the subject thoroughly. Least of all should they place their sole reliance on the claims of the racketeers. This is reminiscent of the racket of some years ago when bullfrogs were offered at fancy prices with the assurance that you could raise bullfrogs any old place and find a ready and lucrative market for frogs' legs.

SAYLOR C. Cubbage, District of Columbia chemistry teacher, writes us that he was trimming the ivy on the front of his house and found an abandoned English sparrow nest tucked away in the vine. "It had the ragged appearance characteristic of these birds," he says. "The sparrows had selected the usual building materials, including dry grass, straw, scraps of string and paper, bits of colored cloth and, in addition, a paper napkin. To prove that they were truly American birds they had included, not a piece of paper money, but a tiny American flag with the staff still attached to it."

R.W.W.



PHOTOGRAPH BY MOULTON B. SMITH

Two specimens of saguaro, the giant cactus of the Southwest. The one on the left is normal and the one on the right is "crested." All crested specimens examined to date have revealed some kind of radioactive material near their roots. This is believed to be the cause of the abnormality of their growth.

Miners of the Plant World

By IDA SMITH

PHOTOGRAPH BY WOODY WILLIAMS

Horsetail plant of the genus *Equisetum*. In certain localities these plants are known to extract gold from the soil. There are some twenty-five known species, universally distributed.

MINING for metals and other elements in the earth has a history that contains many colorful and interesting stories. Thousands of years, however, before the Egyptians discovered gold for their elaborate ornaments, or King Solomon operated his copper mines on the plains of Jordan—the plant ancestors of the "horsetail" were extracting gold from the soil at the rate of four and one-half ounces per ton of horsetail plant. And the precursors of the dandelions that invade our lawns were mining copper far back in geological time.

For many generations the science of economic botany has dealt mainly with plants as related to our more common needs. As miners and metallurgists, however, plants have only recently attracted special attention. Studying them in relation to mining, has created a comparatively new science about which little, in detail, has as yet been recorded. The science is known as geobotany.

Perhaps one of the most dramatic examples, thus far, in this field is the story of selenium. Selenium is a chemical element, discovered in 1817 by J. J. Berzelius. It is widely distributed throughout the world, although in small quantities. It ranks fortieth in order of plentifulness.

Fast on the heels of the discovery of selenium came new uses for it, thanks to experiments by scientists. In the United States the supply of this element is used in the glass industry as a decolorizer to offset the green shade, and to produce the clear, red glass used in railway work. It is used in the production of red enamels, and in special solvents. In rubber, it increases resistance by fifty percent. Metallic selenium is a non-conductor in the dark. In the light, its electrical conductivity is governed by the intensity of the light. From this unusual quality evolved the "selenium cell" and the "selenium compass." In 1891 Prof. Minchin used selenium to measure the light from the stars.

This is an example of only one of the elements and some of its newer uses in modern living, as well as the need for its production.

In 1948 the bulk of selenium mining of the world resulted from the by-products of copper refining. With the decline of copper mining in the United States, much of our selenium had to be imported. So it was with considerable interest that geochemical prospectors discovered that, in soil containing extremely small amounts of selenium, up to 1.5 percent was being "mined" and stored by a pretty little plant called *Astragalus*. This is popularly known as loco-weed, or vetch, and is the weed that stockmen destroy as a deadly enemy to stock, for selenium is poisonous.

Soil in which the plant grows often contains so small an amount of selenium that it would not be practical to extract it direct from the soil. So consideration is being given to growing the selenium-mining loco-weed commercially.

Experiments have been conducted in recent years in an endeavor to unlock the secrets of plant life, especially the mechanics of photosynthesis or carbon assimilation.

PHOTOGRAPH BY MOULTON B. SMITH

Wild tobacco, *Nicotiana rustica*, growing on the Arizona desert after a wet winter. Tobacco is the most active plant "miner" of copper, extracting a great deal from the soil.

By this process leaves convert carbon dioxide from the air, and water into carbohydrates for food, utilizing the sunlight for motive power. As this is the fundamental chemical process upon which all life upon the earth depends, it is one of the most important engineering jobs in the world. So far, to date, the green plant is the master alchemist. Alone, of all living things, it knows the secret of manufacturing food material for itself out of the air. Today, in addition to this research, geochemical scientists, or geobotanists, are investigating plant species as "miners," and their value as indicators of various types of mineral deposits.

In the silent world of plants, multitudes of tiny cells perform their strange and vital work. Some specialize in the manufacture of flowers and fruits, or of exquisite colors and patterns. Others create food from raw materials, or perform chemical tricks with the elements of the earth and air. Each type of cell—the types are countless—specializes in its own work.

Approximately sixty elements have been identified in plants. Most of these, in varying degrees, are necessary to the growth of the plants. Some are necessary to the animal life that feeds upon the plants. The functions of a number of the elements, however, are as yet unknown. Yet, it is believed that nearly all the known elements may eventually be discovered in plant life. Their purposes there may be revealed with the perfecting of more sensitive methods of analysis.

Both the science of botany and of geobotanical prospecting have proved that many plants are selective. It is believed that the endodermal cells in the plant roots have to do with the selection and control of elements drawn from the soil or water into the plant. Some plants appear to have developed more selective abilities than others; some cannot control the effects of certain elements toxic to them in the soil, and die.

A marine alga, *Laminaria*, is known to utilize a large amount of potassium, but limits itself in the absorption of sodium, although sea water contains a much larger proportion of sodium. Some plants will not thrive in copper-saturated soil. Spinach will concentrate a little copper, while tobacco extracts copper with the enthusiasm of a Phelps-Dodge power shovel. A copper-sulphate fertilizer is used by southern tobacco growers in order to produce the big leaves so well advertised. The function of copper in plants is thought to be in the formation of chlorophyll and of oxidative enzymes, but this is still more or less theoretical.

Hickory trees rank high among the botanical metal miners, extracting up to four percent manganese, and thirty-seven percent aluminum.

It has long been known, more or less subconsciously, that the vegetation of certain localities is indicative of their mineral assets. In 1938 the value of such distinctive cover as an aid in prospecting was emphasized and examples cited. For instance, a special variety of violet in Belgium, the *Viola calaminaria*, grows profusely on zinc-rich soils; yellow violets will grow only

PHOTOGRAPH BY MOULTON B. SMITH

Nicotiana, a domesticated and ornamental relative of the tobacco, requires much copper in the soil. The plant's white, bell-like flowers open at night, or in the shade, and close up in the sunshine.

where there is tin in the soil; certain grasses thrive only in areas containing lead.

On the Colorado Plateau it has been observed that one species of vetch, *Astragalus confertifolius*, a bluish, daintily foliaged plant growing on blue mudstone, extracts a low percentage of selenium, but a larger amount of ferrous iron. Where the mudstone contains an excessive amount of selenium, that particular species of vetch is replaced by another, *Astragalus preussii arctus*, which extracts a larger amount of selenium.

The vetch is now classified as a selenium indicator at altitudes up to 6000 feet. Higher than that, another plant takes over, *Stanleya pinnata*, or prince's plume, a tall yellow crucifer that requires a large amount of selenium.

Astragalus preussii arctus and *A. pattersoni* are important selenium indicators of carnotite deposits on the Colorado Plateau due to the association of selenium with uranium ores. These plants seem to tolerate the presence of carnotite, while it is toxic to others.

PHOTOGRAPH BY MOULTON B. SMITH

Normally the Arizona barrel cactus grows in a barrel shape but this one has formed two separate crests due to interference with its growing-center. This is thought to be due to radioactive elements in the soil. This cactus is in the Desert Botanical Gardens in Phoenix, where the curator, W. Taylor Marshall, and his assistants, have been studying the causes of crest phenomena.

In coal districts, investigators have stressed the value of using plant life as indicators. In one area underlain by Cretaceous deposits of coal it was observed that the surface was covered by Siberian conifers, while valleys and foothills, underlain by Tertiary deposits, were covered with birch, alder and spruce.

Saltwort has been found to predominate where the soil is enriched with sodium chloride. Peat moss is known, of course, to grow over peat deposits.

In Wyoming, the devil's paint brush thrives with molybdenum, one of the high-melting metals. It has been proved that molybdenum is necessary to some plants, but its function is not completely known. Vanadium, used as an alloy for hardening steel, is found in pine needles, clover, beans and beets, and is known to be essential to certain of the higher plants. Barium, used in a wide range of chemical compounds, is concentrated by Brazil nuts, while muskmelon leaves have been found to contain the non-metallic element, boron. A very small trace of boron, however, is necessary in all plants in the development of meristem, or growing-center tissues.

Two elements concentrated by plants, but not known to be used by them, are cobalt and iodine. Deficiency of cobalt in the food of herbivorous animals, however, results in forms of anemia; deficiency of iodine, in thyroid abnormality. Certain plants are known to be accumulators of aluminum, but the need for it by plant or animal has not been proved conclusively.

There are three ways in which plants can be used as indicators in prospecting. Some species will show abnormalities of growth, or will die where certain minerals are excessive, while others will thrive there. Other plant species accumulate clearly detectable quantities of certain minerals. Some mineralized areas are typified by certain plant species, thereby creating what is called an indicator flora.

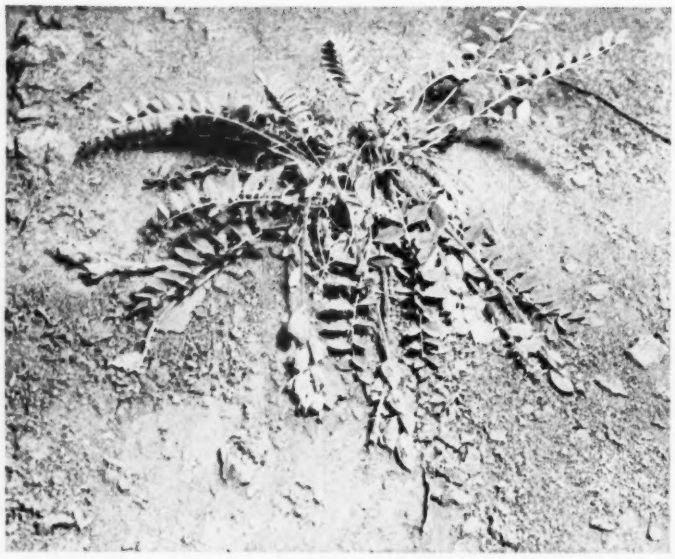
It is believed that one of the abnormalities of some plants—the crest phenomenon—is caused from radioactive elements in the soil. Experiments have been under way for a number of years to test this theory. Desert soil around the base of saguaros with deformed crest was found to be radioactive.

The effects of uranium on plant life was first studied in Japan in 1902. It was found that small amounts of uranium, as well as radium and thorium, were necessary to higher plants and stimulated their growth and development. More than a certain amount proved toxic to them. The amounts of uranium and vanadium absorbed by plants varies with different species, with the time of year and with chemical combinations in the habitat. Tests made recently on a New York farm, using radioactive cobalt, disclosed that the correct

amount of cobalt quickly produced many new variations in plants that only years of breeding could otherwise have duplicated.

Extensive experiments have been made by the United States Geological Survey for the Atomic Energy Commission on the Colorado Plateau to determine species of plants that may be used as uranium and vanadium indicators. There is only a small amount of literature on the amounts of absorption of uranium and their effects on plants growing naturally. On the Colorado Plateau combinations of uranium, vanadium and selenium are absorbed readily in unusual amounts by plant species there. A still higher uranium content is found in plant species growing near pitchblende deposits in Canada.

One curious and little-known fact, observed in uranium districts, is the replacement of the common, narrow-leafed saltbush, *Atriplex canescens*, by the wide-leafed, shad-scale salt-bush, *Atriplex confertifolia*, in soil containing larger amounts of mineral salt. This marked change in the appearance of the vegetation may have been used subconsciously by early prospectors, geologists believe.



PHOTOGRAPH BY MOULTON B. SMITH

One of the vetches, plants that have been found to be outstanding indicators of the presence of selenium in the soil.

Varying methods are used for determining the mineral content of plants. To ascertain the percentage of mineral actually absorbed by the plant, it is washed to remove any residue clinging to the outer surfaces. Then leaves and stems are ashed and the ash analyzed. The behavior of plant cells also reveals to the biochemical prospector the abundance or the deficiency of the different chemical elements in the soil from which the plant grows. However, numerous factors enter in, such as species of plants, their age, time of year, composition of soil, climatic conditions, and such.

Indicators have given positive results in the forests of Sweden in prospecting for gold, tungsten, molybdenum, tin and other metals. In the Far East beach grass, or reed grass, *Calamagrostis*, is an indicator to locate iron.

In the Thompsons district of the Colorado Plateau, some of the plants that have been identified as tolerating highly mineralized soil are rabbitbrush, shadscale, Mormon tea, vetch, and several grasses. On the higher mesas they are junipers, scrub oak, serviceberry and cliffrose.

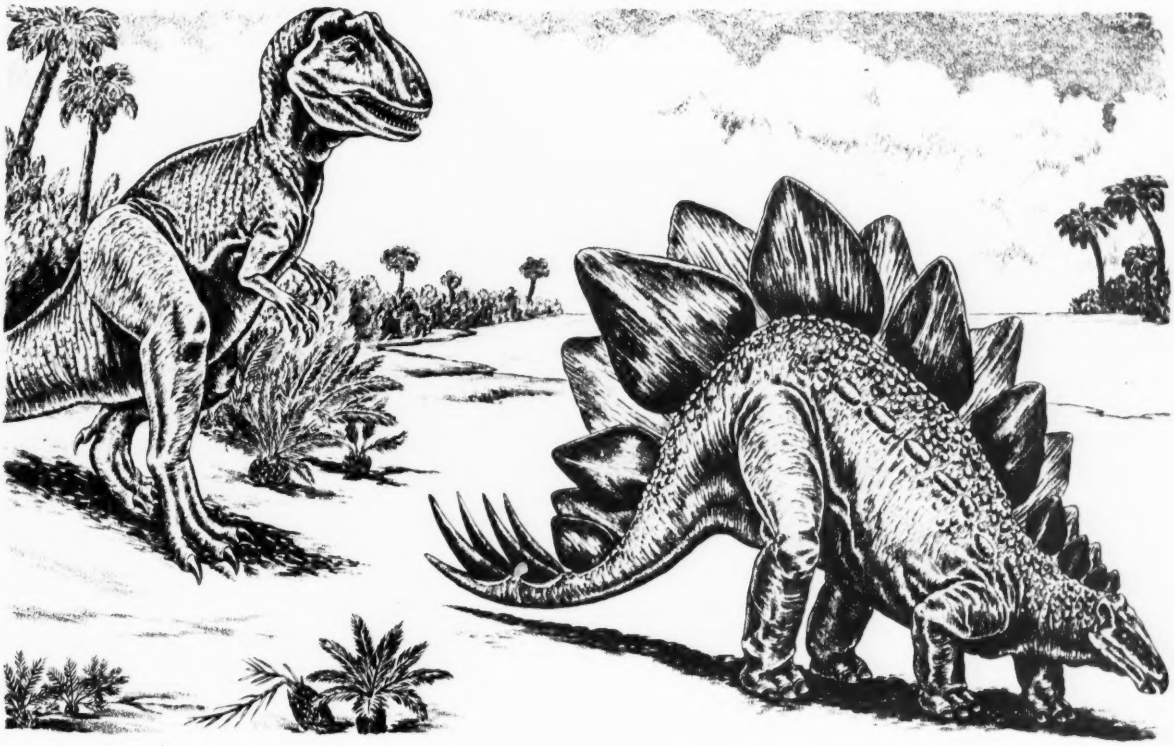
Years ago only a few of the 92 natural elements in use today were well known. With the discovery of new elements, vast fields of uses are found for them. In the recovery of these elements, geobotanical research is proving a valuable aid in probing the secrets locked up in the silent miners of the world of plants.

★

California November

By RUTH SEYMOUR VESELY

The day was warm, and when the sun had flung
His scarlet shield behind the coastal range,
The sky became a massive canvas hung
Above the town and valley. It was strange
To see trees glowing black, each twig and leaf
Superbly etched upon a saffron sky
While pyracantha berries kindled brief
Ecstatic fires on the shrubs nearby.
Then in the twilight and the creeping chill,
Forecasting nights as cold as ocean's breath,
Was heard a wistful chirp; one cricket still
Unwilling to accept the summer's death.



Allosaurus, about thirty-five feet long, was one of the dinosaurs that ate meat and preyed upon herbivores such as the "thunder lizard." Here he is trying to attack a well-armored land dweller.

Dinosaurian Giants

By CARROLL LANE FENTON

Drawings by the Author

OUR familiar word "dinosaur" is both useful and deceptive. It is useful because it fits an array of extinct reptiles that lived during the Mesozoic era, a division of earth's history that began some 200 million years ago and closed about 70,000,000 B. C. The name is deceptive because it implies that all those reptiles were related, and that all were "terrible" giants. Actually, dinosaurs belonged to two groups as different as alligators and lizards, or horses and elephants. Many forms also were small, with weights that ranged from six or eight to fifty pounds. Finally, although some carnivorous dinosaurs were bipeds thirty to forty-eight feet long, the real giants were peaceful plant-eating quadrupeds that avoided danger and harmed other animals only by accident.

Even these great reptiles had relatively small beginnings. We trace them in creatures that roamed through valleys of New England about 160 million years ago. They were six to eight feet long—a large alligator is eleven—walked on two legs or four, and stood half erect by balancing themselves with their tails. They probably ate a mixed diet of small animals and plants, although we must guess at dinosaur diets.

After these pioneers comes a gap, with just enough fossils to show that plant-eaters made slow progress for some 40 million years. Then they became both widespread and abundant, and reached their greatest size.

Their triumph is best recorded in the Morrison formation, a series of clays, shales and sandstones that extends from New Mexico to Montana, and from eastern Utah to Denver. These sediments settled in swamps and shallow lakes, or were piled up in bars by rivers that wandered across low-lying plains. The climate was mild and moist, for cycads, ginkgos, and conifers formed thick forests, shading an undergrowth made up largely of ferns. Scouring rushes and succulent plants grew abundantly in the swamps.

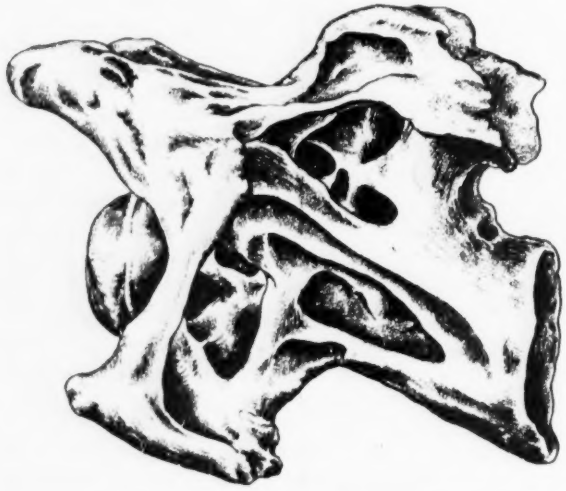
Both swamps and meandering streams were the homes of herbivorous dinosaurs. Best known was the so-called thunder lizard, whose technical name has recently been changed to *Apatosaurus*. It was sixty-five to seventy-seven feet long, with a deep, short body, a flexible neck, and a tail that was massive near

the hips, but ended in a whiplash tip. The feet were as much as twenty-six inches wide and padded like those of an elephant. Some toes were mere stubs, but those that were fully developed bore claws—one on each forefoot, but three massive claws behind. The creature's weight is estimated at thirty-five to forty tons.

As the thunder lizard lolled in swamps and bayous, it encountered a relative known as *Diplodocus*, which reached lengths of eighty to eighty-seven feet, and was thirteen feet tall at the curve of the back. Almost one-third of the length was neck, and half consisted of tail. *Diplodocus* therefore weighed only twenty tons, about five times as much as a good-sized elephant.

In front of this enormous bulk was a weak-looking head about two feet long. The nostrils opened between the eyes and above them, instead of upon the snout. The muzzle sloped down to the jaws; the blunt teeth slanted outward; the brain was a smooth, diminutive organ weighing only a few ounces. It was just able to sort out messages of sight, hearing and smell, passing them on to ganglia that took care of such jobs as wading, swinging the tail, or reaching out for food. These activities, plus mating and somnolent resting, filled the life of *Diplodocus*. Thinking was a luxury in which he could not indulge.

Largest of all was *Brachiosaurus*, whose remains have been found in East Africa as well as in western Colorado. Unlike other great herbivores, this giant had such long forelegs that its back sloped tailward like that of a giraffe. One individual stood nineteen feet high at the shoulder, had a twenty-eight-foot neck, and ordinarily carried his head at a height of thirty-eight feet. Although the tail was relatively short, the total length equalled that of a large *Apatosaurus*. A massive sixteen-foot body brought the weight to forty or forty-five tons. The brain, however, weighed seven ounces and was no more efficient than that of *Diplodocus*.



This vertebra from the neck of *Apatosaurus* shows how bars and plates gave strength without great weight.

***Diplodocus*, the longest known dinosaur, had nostrils between and above his eyes.**

These are measurements of a skeleton that had not achieved full growth. Other bones are as much as thirteen percent larger. They indicate animals forty-four feet high and eighty-four feet long, with weights approaching fifty tons.

Besides being the world's largest reptiles, these dinosaurs were the biggest animals that ever lived on land. To reach such sizes they did more than eat and grow; they unconsciously solved engineering problems by means of muscles, bones and habits.

The most immediate problem was that of providing a framework for an enormous body. Part of that framework consisted of ribs, but the critical portion was the backbone. Its vertebrae had to be big as well as strong, yet they could not be solid without having more weight than the legs were able to support. The solution was found in hereditary changes that turned each vertebra into crossbraced plates and bars that met every conceivable stress with a minimum of weight. The entire column suggests a modern steel bridge, although it was held together by ligaments and interlocking joints rather than by bolts or rivets.

The body, once framed, had to be supported, a task performed by the legs. They were massive columns, those in front being slightly bowed. Their size may be gauged from the upper "arm" bone, or humerus, of *Brachiosaurus*, which was seven feet long and ten inches wide near the middle of the shaft. The thigh bone of the thunder lizard was thicker and was six feet, six inches in length.

Even these limbs could not support the great herbivores. Proof of this is found in the ends of the bones,

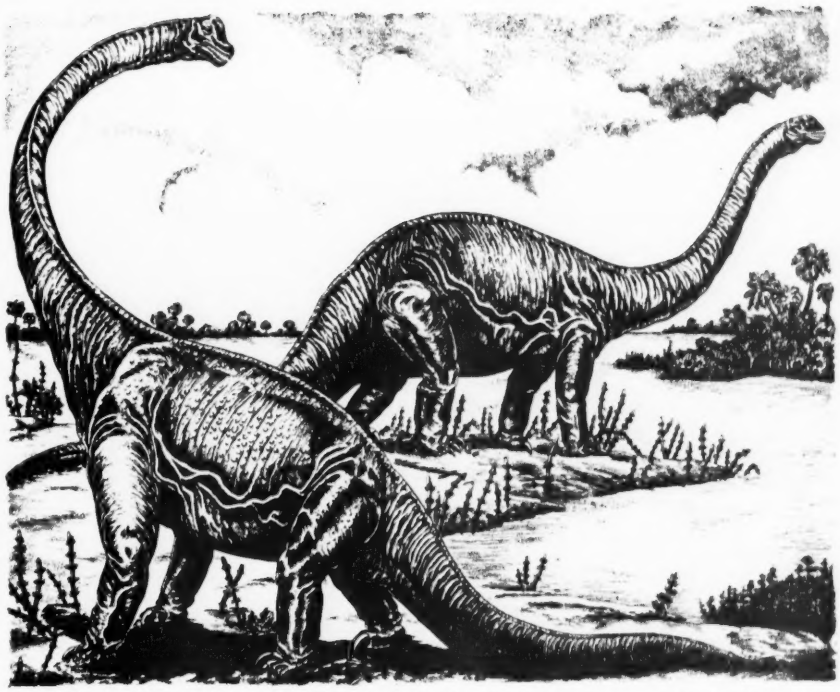
which were gristly instead of solid. On land they would have been crushed—but the reptiles undoubtedly stayed in water, which buoyed up their bodies so much that their legs could support the weight that remained.

Brachiosaurs and their kin were much too big to swim and dive actively, in the manner of alligators. We picture them as leisurely waders, which often went into water so deep that their backs, necks and heads were submerged. Only their elevated nostrils projected, enabling the animals to breathe even when they stood in thirty to forty-five feet of water.

These facts, inferred from skeletons, were elaborated when fossil trails were found along the Paluxy River, not far from Glen Rose, Texas. Sometimes the animals waded on all fours, generally with the tail afloat, although now and then it dragged on the bottom, making a furrow between the footprints. At other times the dinosaurs waded with the forelegs and swam with the hind. When they wanted to turn they kicked sidewise with such vigor that their massive claws dug into the mud.

Some of the Glen Rose tracks also explain why the great herbivores often waded into deep water, with only their nostrils exposed. The reason was bipedal carnivores twenty-eight to thirty-five feet long, with strength and appetites in proportion. These meat-eaters often hunted on land, but they also stalked herbivorous giants in swamps ten to fifteen feet deep. The only way their victims could escape was to take refuge in water that came over the carnivores' heads.

One other problem had to be solved: that of producing young ones. Most aquatic reptiles go ashore to lay eggs, but the great plant-eating dinosaurs could not do that because the ends of their leg bones were not hard. We conclude that the females kept their eggs in their bodies until they hatched, a method now employed by some lizards and many snakes. The newly hatched young must have gone to shallows, where they could feed and breathe even though the water was too shallow for safety from terrestrial carnivores.



Brachiosaurus **(left) and** ***Apatosaurus*** **(right), the largest of plant-eating dinosaurs. Both lived in the American West, although Brachiosaurus ranged as far as East Africa.**

Animal Towns

By HARRY W. GITHENS

MORE than three-score communities throughout the United States would appear to be the abiding place of either domestic or wild animals, according to their peculiar names, yet no citizens have ever seemed fearful of residing in them. Let us consider where these animal communities are located: BUFFALO—New York, Arkansas, Wyoming, Minnesota, Alabama, Illinois, North Dakota, South Dakota, Oklahoma, Pennsylvania, Texas, and West Virginia; BADGER—Minnesota, South Dakota; BEAVER—Arkansas, Kansas, Louisiana, Ohio, Oklahoma, Oregon, Pennsylvania, Utah, Washington and Wisconsin; COLT—Arkansas; DEER—Arkansas; FOX—Arkansas, Michigan, Oregon, Virginia; ANTELOPE—California, Oregon, North Dakota, Texas; CARIBOU—California; COYOTE—California and New Mexico; ELK—California, New Mexico, Washington, West Virginia, and Wyoming; WOLF—California, New Mexico, Ohio, Wyoming; PONY—Montana; TIGER—Colorado, Georgia, Washington; BEAR—Delaware and Idaho; SQUIRREL—Idaho; BISON—Kansas, Montana, Oklahoma, South Dakota; BLACK WOLF—Kansas; HORSE—Kentucky; LAMB—Kentucky; OTTER—Kentucky, Montana; RACCOON—Kentucky; WILD CAT—Kentucky, West Virginia, Wyoming; PANTHER—Pennsylvania, West Virginia; PORCUPINE—South Dakota; MOOSE—Wyoming.

The Issue at Three Sisters

By RUTH E. HOPSON

Photographs by the Author, Map by Beth Beckelhymer

In *Nature Magazine* for August-September, 1951, the author described the Three Sisters area in detail, as she did in the September-October, 1951, issue of *Pacific Discovery* Now the question of boundaries is at issue, with many conservation groups at odds with the proposals made. In this present article Miss Hopson, mountaineer and active western conservationist, brings us up to date on this question.

A BASIC wilderness issue is at stake in the reclassification of the Three Sisters Primitive Area into the Three Sisters Wilderness Area. Since 1950, when the intention of the United States Forest Service to reduce the Three Sisters area first became known, the Federation of Western Outdoor Clubs and its member societies—especially the Obsidians, Mazamas, and Sierra Club—as well as the Eugene Natural History Society, the Oregon Academy of Sciences, the Wilderness Society, the Oregon chapter of Nature Conservancy, and a number of individual scientists have been studying the proposals. These groups and the Forest Service differ as to the future of the steep western slope of the Horse Creek drainage, comprising approximately twenty square miles or 12,400 acres. This slope leads to the first ridge of the older Cascades, and thus into a type of region not elsewhere under protection.

North, Middle, and South Sisters from an open spot on the Olallie Trail. The deep canyons are Horse Creek and Separation Creek.

Public notice was served May 28, 1954, of the intention of the United States Forest Service to modify the existing Three Sisters Primitive Area, reclassifying it under regulation U-1 of the Secretary of Agriculture, as the Three Sisters Wilderness Area. A public hearing will be held about the first of December.

The Three Sisters Primitive Area was established May 28, 1937, under Regulation L-20 of the Secretary of Agriculture. The Forest Service proposes to modify the existing boundaries of the primitive area by eliminating 55,620 acres on the present western boundary and adding 5532 acres on the northern and eastern boundaries. Approximately 12,400 acres between Horse Creek-Eugene Creek and the Horsepasture Mountain-Olallie Mountain ridge are in dispute.

The same public notice states the intention to establish two new wild areas—Mount Washington and Diamond Peak. In providing wilderness and wild areas, the aim has been to protect the Pacific Crest Trail. The proposed additions of Mount Washington and Diamond Peak Wild areas, north and south of the Three Sisters Wilderness Area, are to this end. This is a marvelous high country of prime recreational importance and scenic beauty. However, from the standpoint of adequate examples of various kinds of habitats in their natural state, both for recreation and for study, these areas are not trading stock for the disputed western half of the Horse Creek-Eugene Creek drainage and the high ridge.

Over most wilderness trails in the Cascade Mountains of Oregon, one wends his way in the "high country" through forests of lodgepole pine, associated with

Packer Frank Riley en route to Olallie Guard Station with dunage for some fifty hikers. The typical forest of the western ridges of the older Cascades shows the dominance of true firs and the lack of lodgepole pine. The open area is one of the alder seeps in which, in early July, the snow has just melted. Soon this will be a profusion of wild flowers.

various other pines and true firs, up to the timberline forests where pure stands of mountain hemlock alternate with groves of alpine fir and whitebark pine, or occasionally above the trees and out into the region above timberline. By "high country" is meant the crest of the Cascades. Here the Pliocene shield volcanoes, such as Mount Washington and Three Fingered Jack, were carved to "horns" by the action of the Pleistocene glaciers. Magnificent complex volcanoes like Middle and South Sisters, Mount Jefferson and Mount Hood were built during intermittent volcanic and glacial activity of the Pleistocene, or Ice Age. Vulcanism has continued to build cinder cones and to spill out lava flows as recently as a few hundred years ago, or less.

But there are other wilderness trails to the west of the "high" Cascades. These are also high! They follow the crest ridges that were carved from older rocks, mostly Miocene to Pliocene in age. These rocks are also volcanic, but the original volcanoes, if there were such, are gone—erased by erosion. Or perhaps the rocks are remains of lava that flowed from vents. This region is made up of high ridges and deep, steep-sided valleys with a few plug-type peaks that rise above the ridges. The timber of these valley sides is in some cases large and old. It consists of Douglas fir, incense and western red cedar, sugar and western white pine, western hemlock, and grand fir, changing gradually on the upper slopes and ridges to the high forest of true firs—noble fir, amabilis fir, alpine fir, mountain hemlock and whitebark pine. Remnants of the lower species are intermingled. This forest approaches a "climax" forest with associated shrubs and herbaceous plants. Specifically, the flora of the ridge region differs from that found in the "high" Cascades in the absence of lodgepole pine (except in the Olallie Mountain region) and in the presence of sugar pine. The forest of the "high" Cascades at the same elevation is more than fifty percent lodgepole pine, lacks sugar pine, and has very little western white pine or noble fir. This ridge forest represents an older forest in which there is a meeting of species from the north, south, east, and west and from the lowlands as well as the highlands.

My records, based on too few trips to be conclusive, show approximately fifty species of plants from the Horsepasture Mountain area that were not found in the younger or "high" Cascades. Some of these are plants that also occur in the lower country to the west, not now under protection. Others seem to be rare except in the type of location represented by this disputed area. Among these rarer plants are Anderson's shield fern, Cascade onion, two subspecies of the broad-leaved lupine, Douglas maple, western twayblade, Sitka alder, mountain meadow knotweed, Jimpson knotweed, Douglas campion, matted saxifrage, Merten's saxifrage, great polemonium, many-flowered tickweed, Oregon lungwort, mountain orthocarpus, Cardwell's penstemon, and broad-leaved arnica.

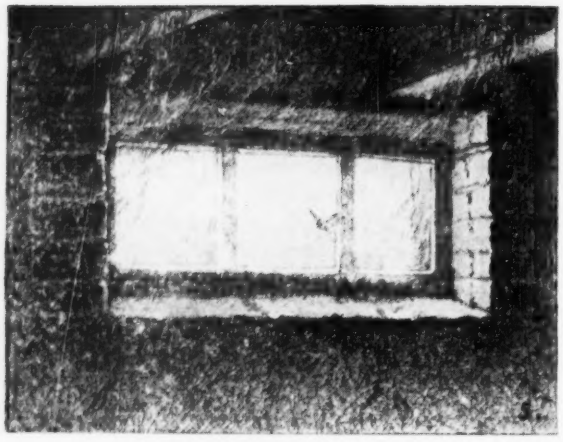
Over the Fourth of July week-end, 1954, the Federation of Western Outdoor Clubs sponsored a pack trip approximately around the boundaries of the disputed area. Fifty-eight persons, including Forest Service personnel, took part in the three-day trip. The party hiked from Horse Creek up (Continued on page 500)

On the trail below Lamb Butte, a glimpse of the Middle Sister through western white pine and squaw grass greeted the hikers.

The Uneasy Sleep of Winter Butterflies

By HOWARD J. SHANNON

Illustrated by the Author



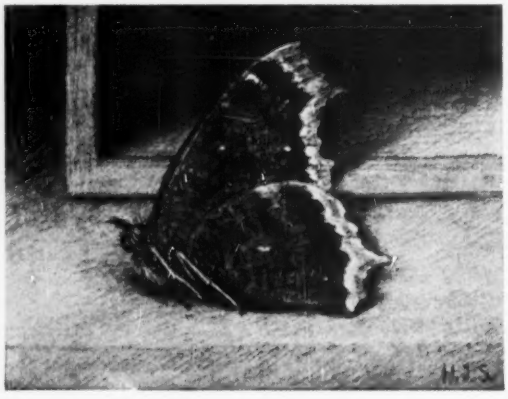
An awakened butterfly flutters at the cellar's sunny window.

LITTLE did I realize how delightfully my prosaic labors would be enlivened when, on a cold morning in early November, I first kindled my furnace fire in our cellar. Almost at once a fluttering noise was heard at the sunny southern window-pane. It was a large, dusky-winged butterfly. Resting on the window-sill with royal composure, it was slowly opening, closing and again expanding its yellow-bordered, brownish wings. It was a mourning cloak, the most familiar representative of our hibernating butterflies, wakened by the furnace heat.

Certainly it could not be left to struggle wakefully here; some more appropriate sanctuary must be provided. A moderate-sized box with sliding cover had already been provided for a still earlier awakener, another mourning cloak found at that same cellar window by my aunt. So the butterfly was captured and put in a like container, which was carefully placed on a sideboard in a secluded winter studio. Now, side by side, rested the two boxes with their interesting inmates. The butterflies were destined, I supposed, for the deep, untroubled repose of a long winter sleep.

But their silence was deceptive. So I completely failed to foresee the adventures that lay ahead. Nor could I even imagine the revelations of butterfly traits that would appear as the insects, although disposed toward an ever more profound hibernating sleep, were roused, again and again, to wakeful activities of striking variety and interest.

Even in the wintry wilds the mourning cloak is distinguished for its fitful behavior. Other hibernating butterflies remain, for the most part, truly dormant. Of course, most butterflies of the higher type survive the winter in pupal form, while others live on as eggs or larvae, some of the latter being fully mature as they enter the hibernating state, others only partly so. The well-known angle-wings all hibernate as butterflies; red admirals and painted ladies as butterflies or pupae. But the ebullient vitality of our mourning cloak enables it to enliven the outdoors with temporary flights that occur in every month of the year.



The death-feigning posture of a mourning cloak butterfly.

Already the first mourning cloak, the one captured on October 1, had resorted to a ruse characteristic of the species. After it had been placed in the box, the insect lay inert on its side. With wings folded, it simulated death. But this was only a deception, a trick instinctive in the wild to thwart enemies seeking only living prey. Unaware that its present surroundings were friendly, the butterfly had automatically resorted to this protective device. Reassurance soon followed. For when the box-cover was lifted a few days later, there the prisoner stood, firmly erect and immobile, in what I soon learned to recognize as its habitual hibernating pose. It remained so for nearly a week.

Other mysterious adjustments soon followed. When the cover was lifted again I saw that the antennae had moved. They were no longer held so nearly perpendicular that they were hidden by the wings but, by a forward movement, they had become visibly alert and inquiring. Although these organs are essentially informative, one can hardly surmise the object of their search. Mouth parts, too,—the palpi—were moving. These were, indications of an inner disquiet, and the creature had not yet sunk into the complete somnolence of a final hibernation.

Mild weather and outdoor temperatures rising to 72°, roused *antiopas* from hidden crannies, either in my own yard or in others nearby. Two fully awakened *antiopas*, *Ag-*

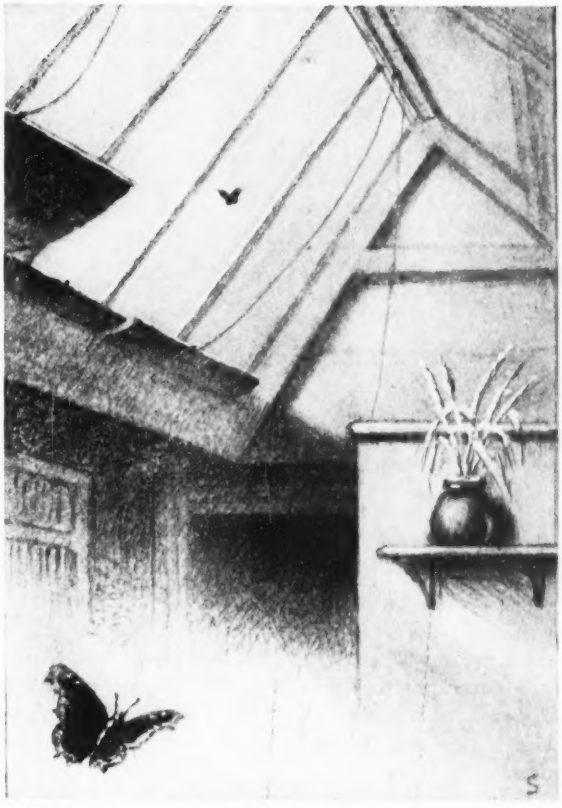
lais antiopa, were seen flying about the streets as vigorously as they would be in spring. So it was not strange that the mourning cloak my aunt had found should be similarly affected. On October 17 a fluttering protest came from the butterfly's narrow confines. Two days later this fluttering became so violent that the inmate was lifted from its box, and placed beneath a large glass cover along with a small dish of crushed apple. When I returned to the room, after a brief absence, the creature had been attracted to the food. With long curved tongue immersed in the apple juice, it was a picture of satisfied desire. Then, after three-quarters of an hour of complete immobility, feeding was resumed. Apparently invigorated now, and stimulated further by the room's warmth, the butterfly began expanding, closing and again expanding its dusky wings only to return, after a time, to complete immobility. Evidently *antiopa* sleeps lightly at first, wakens readily when temperatures rise, desires and, if possible, acquires food, then returns to temporary sleep. No doubt a similar cycle is repeated in the fields.

However, the butterfly's true reposeful posture had not yet been attained. After the insect had been returned to the box for twenty-four hours, a cautious examination showed it had assumed an entirely new attitude. Firmly attached to the side of the box, head directed upward and wings closed and dependent, the creature clung there in a position that it seemed to find the most acceptable. This posture remained unchanged for several cool days, and as, by this time, the second *antiopa* was under observation, also, periodic violations of their privacy showed both similarly immobile as chilly weather continued.

Now came a real surprise. In response to an unusually hot furnace fire *another* mourning cloak awoke in that butterfly-haunted cellar! After it had been briefly studied under glass, this one, too, was offered a domicile similar to that provided for the others.

Thanksgiving Day came, and, both indoors and out, mourning cloaks were wide awake, and superlatively active! Although outdoor temperatures were in the neighborhood of 45°, one of these butterflies was seen flying across the street in front of the house. Others must have been flying about also, for evidently this year must have been an exceptional one for this species. Within doors, their relative, hibernator No. 1, became so obstreperous that it was liberated to fly freely and gratefully about the room. The two others preserved their immobile pose.

December came, and every noon day, when the temperature rose to 58°, or higher, *antiopa* No. 1 became so restless that it was released. Immediately it flew either to the south window or winged far up to the skylight's peak where it circled about, then settled to rest after its ambitious flight. How differently these three hibernators reacted to the same temperature! No. 1, the first to waken in the cellar, showed the most consistent responsiveness to an elevated temperature, while No. 3, the last to waken in the cellar, remained throughout the most dormant of all.

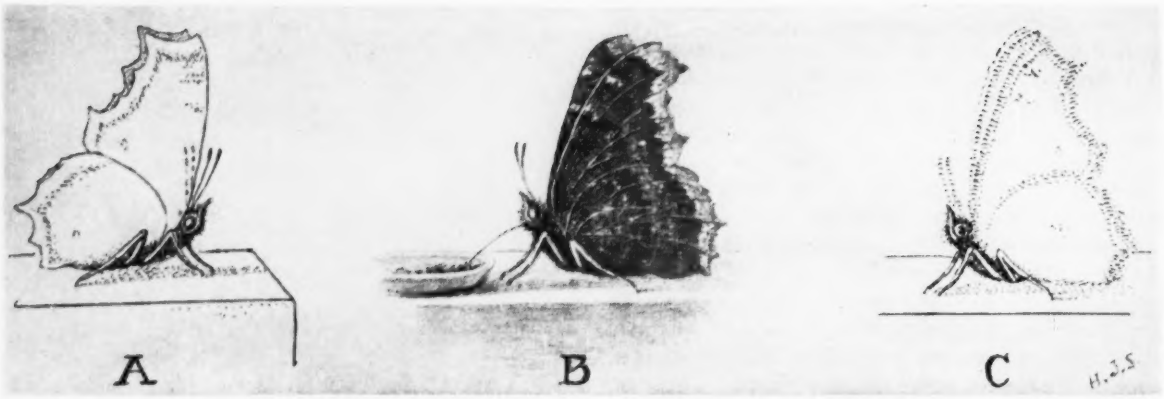


With its companion, the butterfly ascends to the skylight's peak, where it freely circles.

Awakened by warmth, the mourning cloak is freed from its shelter and flies out into the room.

The excessive activity of No. 1 assumed a more violent form as winter deepened, and noonday succeeded noonday. The butterfly's restlessness became so pronounced that, again and again, it was released. With characteristic vigor it would fly to the warm south window, where it would resentfully flutter and beat its head against the glass. Then, after settling to rest, it would extend its tongue until it made contact with the window-frame.

Such significant behavior could hardly be interpreted



(A) Early adjustments of an awakened butterfly. Its antennae, formerly hidden, assume a pose of alert inquiry. (B) Because of its restless flights, the butterfly requires food. (C) Overcome by a mysterious reaction, the mourning cloak's shuddering wings give forth a rustling murmur.

as anything else than a desperate craving for food. So *antiopa*'s wish was granted. But I was totally unprepared for the startling behavior that followed this welcome repast. Almost immediately the mourning cloak became affected by a fine, continuous shuddering, so intense that the steadily quivering wings emitted a dry rustling murmur. Even the antennae were trembling; and this curious behavior continued for some time.

Other observers have described this same tremulous rustling of a butterfly's wings and, significantly enough, in hibernators. One startling example occurred on a winter's day when a Rev. Mr. Green in England, after thrusting an inquiring hand into a hollow tree, aroused such a violent hissing that he hastily withdrew. Further exploration uncovered not an adder but the agitated wings of a flock of hibernating European peacock butterflies, *Nymphalis io*. Similar grating sounds, noted by a Mr. A. H. Jones and quoted by Dr. Samuel Scudder, were readily traced to the quivering wings of a mourning cloak disturbed while in hibernation. This same famous lepidopterist has noted a similar agitated quiver of a butterfly's wings when an intruder has alighted upon the same flower-head. He believed the vibration was intended as a warning.

Strangely enough, similar agitations of butterfly wings were dramatically exhibited when, in an attempt to trace the southward autumn course of many migrant monarchs, I once marked their flight structures by punching a small, and presumably harmless, disc from the hinder wing. When the butterflies were released to resume their clinging postures upon nearby vegetation, some of them fell to the ground with helpless and shuddering wings. Their flight organs seemed unable to react except by this agitated tremor. Did the small hole, I had so considerately punctured, suggest the alarming peck of a bird's beak, and thus prompt the butterfly to fall and simulate death? Or was the reaction an indication of shock or fear?

Perhaps the true reason for the monarch's behavior, and that of the housed mourning cloak, too, is much the same, namely, the extraordinary physiological condition imposed by migration on the one hand, and by hibernation on the other. For, after a day-long journey, the monarchs had not only sunk to evening rest but they were also possessed by the semi-hypnosis of the migratory instinct, while the *antiopa* was partly inhibited by the somnolence of an interrupted hibernation. Hence neither insect could escape from threatening danger by flight. Only this shuddering of a resentful wing-reaction remained.

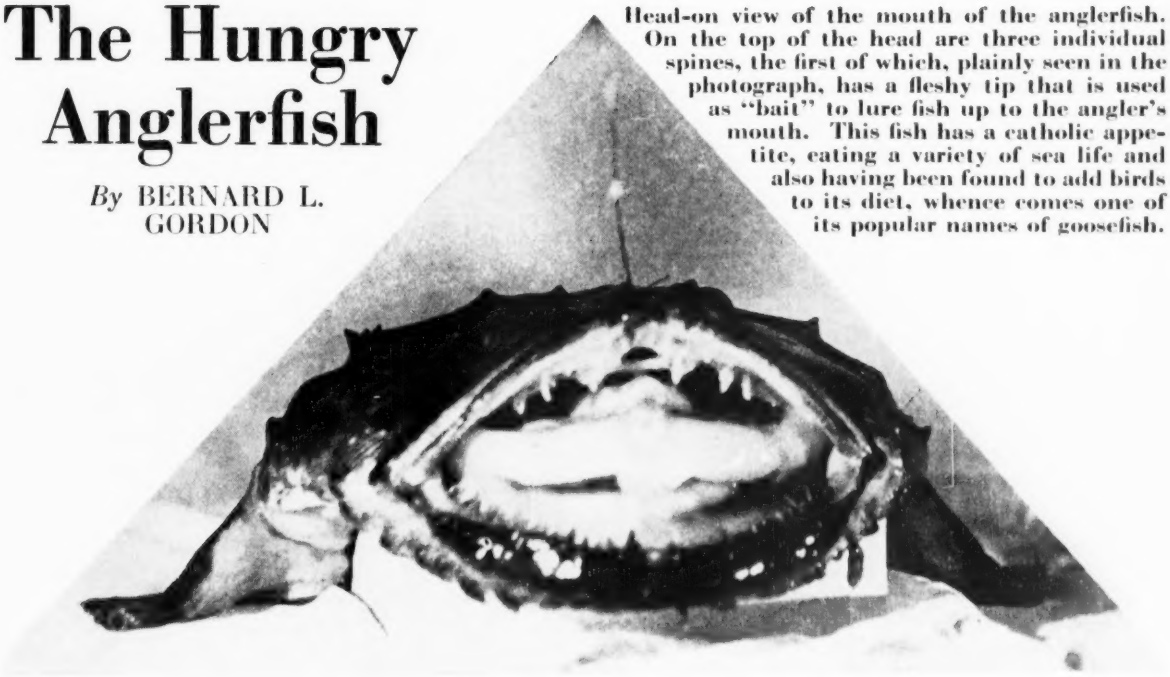
Yet how difficult it is to know with complete certainty the true explanation of these troubled agitations. Possessed with an organization so peculiarly responsive to variations in atmospheric pressure, to the more delicate fluctuations of temperature, and to all those electrical, and even less definable factors so inherent in its aerial environment, the butterfly becomes a veritable musical instrument upon which Nature plays a moving and ever-varying theme. When successfully responsive to this, and therefore with an effective behavior-pattern, the insect has survived, as is shown by those tribes that have conquered winter's cold by migration or by hibernation.

Unfortunately there was another large group that failed. *Its* members are known to us only by fossil types, particularly by the sub-tropical genera of the early Tertiary Era. They were unable, we may assume, to adapt themselves, or even their descendants, to the changing climate preceding and accompanying the Ice Age. Thus no descendants of these prehistoric, subtropical species lived on in the North to gladden our eyes today.

Almost equally disregarded is the present-day decimation of individuals. And to a considerable extent, the cause is similar. Few of the monarch butterflies that fly South in autumn ever return to the North in spring. Likewise, many hibernators, whether in larval, pupal or imaginal form, are unable to survive the rigors of winter. (Continued on page 500)

The Hungry Anglerfish

By BERNARD L. GORDON



Head-on view of the mouth of the anglerfish. On the top of the head are three individual spines, the first of which, plainly seen in the photograph, has a fleshy tip that is used as "bait" to lure fish up to the angler's mouth. This fish has a catholic appetite, eating a variety of sea life and also having been found to add birds to its diet, whence comes one of its popular names of goosefish.

FAMILIAR to almost every commercial fisherman on our northeast Atlantic coast is a somewhat grotesque, conical-shaped fish of the sea. It has received many names since the first description of its habits was given by Aristotle, some twenty-three hundred years ago. Some of its more commoner names are anglerfish, goosefish, molykite, bellyfish, frogfish, all-bellows, monk-fish, sea-devil, all-mouth and, by the French, names of *baudroie* and *poisson-pecheur*.

Regularly taken by draggers with otter-trawl nets in both inshore and offshore waters from Newfoundland to Cape Hatteras, the anglers are seldom shipped to market in any great quantity. Indeed, they are usually put in with trash fish by the fishermen, or thrown back overboard.

Having so distinctive and grotesque an appearance, the angler can easily be recognized at first glance. Unusual features are its large, gaping jaws, with four rows of sharp, pointed teeth directed inwardly; its conically shaped body, tapering toward the tail; its strange pectoral fins, which, instead of rising from the sides of the body as in most bony fishes, take the form of fleshy arms formed by the elongation of the carpal, or wrist bones, and project out from the base of the head. On the lower jaw, and extending in a straight line along the sides of the body, are a fringe of barbels, or fleshy projections, resembling small pieces of seaweed. These are best developed on the lower jaw, where some of them may be two inches long. Located on top of the head are three individual spines, the first of which has a fleshy tip that is used as "bait" to lure fish up to the angler's mouth.

Descriptions of the angler using the spines or rods on its head to attract fish have been given by W. F. Clapp of Duxbury, Massachusetts, and by Chadwick, 1929, and Wilson, 1937. Wilson, who made quite a study of the angler's habits, states: "An angler when hungry erects the first spine immediately when any suitable fish comes anywhere near and endeavors to attract one of them close enough to be caught. The lure is jerked quickly to and fro and, since the spine is almost invisible, the bait, which is 'fly like,' simulates some tiny creature darting about. An attracted fish rushes up in an attempt to catch it; the bait is skillfully flicked out of its way just in time, and, with a final cast, is dashed down in front of the mouth, which may open very slightly. The intended victim, still following the bait, turns slightly head downward; it is now more or less directly in front of the angler's mouth. The jaws snap faster than the eyes can follow, and the tail of the prey is next seen disappearing from sight through the firmly closed mouth. . .When the moment comes to strike the prey it seems that the angler suddenly thrusts itself a short way upward and forward with the aid of the pelvic fins against the ground. Little assistance appears to be given by the pectorals, at the same instant the mouth opens and presumably the buccal cavity is rapidly enlarged, sucking in water and the fish at the same time. The jaws snap and the angler sinks back into its sandy hollow to swallow its captive in leisurely fashion."

It is reported that the molykite will eat almost anything. It is known to have swallowed wooden buoys attached to lobster traps, and there have been reports of persons hauling up an anchor that had hooked a molykite. Rondolet tells of finding an angler along the shore holding a fox fast by the leg.

There have been quite a few accounts of anglers

swallowing water birds. Seven wild ducks are said to have been found in the stomach of one angler, and six coots in another. This fish is sometimes called the goosefish because it is known to have swallowed some geese that were floating serenely on the surface of the water.

However, the usual food of the angler in New England waters appears to be herring, flounder, whiting, sculpin, cod, haddock, skate and sandshark. In other words, it likes any fish into which it is able to get its efficient teeth.

Prent Lamphere of Watch Hill, Rhode Island, while out hand-lining for cod on the reef off Weekapaug, Rhode Island, was hauling up a fish when all at once he found the line had suddenly grown a lot heavier. He hauled it up as quickly as he could and found that he had hooked a cod but it was swallowed by an angler while he was pulling it up. There have been several accounts of similar circumstances by other deep-sea fishermen.

When large anglers are captured in otter trawls they are likely to be found with the tails of three or four fish sticking out of their mouths. It seems that when they find themselves among thousands of fishes they promptly take advantage of the situation and eat as many of their companions as they have capacity to hold. I have even seen a small molykite, with several small fishes in its mouth, trapped in the mouth of a larger molykite.

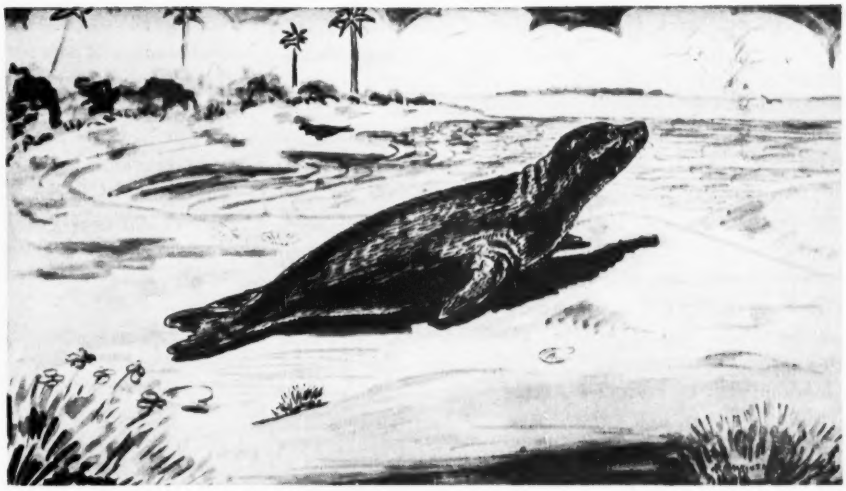
Anglers are most common in New England waters during the summer months, when they spawn and are found regularly in inshore waters. The eggs of mature anglers are extruded in a mucus-like mass that extends for about thirty to forty feet long and is about one foot wide. The eggs are violet-gray in color and float near the surface. Frequently they are found attached to lobster trap floats and fish traps. Estimates of the number of eggs released by a large female runs from one to three million.

There is not any doubt that the anglers are a tasty food fish. The flesh is firm and white and especially suitable for frying or baking. European countries have been utilizing the angler as a staple food fish for many years. In some places it is even regarded as a delicacy. It was introduced on the New York market in the summer of 1918, and has been sold there in comparatively small quantities ever since, despite the fact that it is popular with some epicures.

The average adult angler is about forty-two inches long and weighs about twenty-eight pounds. Of this weight about ten pounds are marketable. There is a great deal of waste because of the fish's large head. If the head is cut off as soon as it is caught, what is left can be easily handled and most of it is good meat. The flesh on both sides of the backbone is entirely free of bones and can be easily cut up into delicious steaks. Anglers reach a length of five feet and have been recorded as heavy as seventy pounds. Occasionally a large angler will get stranded by the tide on a beach. Frequently beachcombers encounter angler's skulls and jaws.

Hauling aboard a large anglerfish from a fish trap at Point Judith, Rhode Island. No beauty, this fish is regarded by many as a fish delicacy.

Normally the anglers are found on the bottom but occasionally they appear on the surface. Old-time fishermen say that they usually come during a storm. European fishermen believe that the appearance of an angler heralds an approaching storm. This idea is also found on this side of the Atlantic for, according to Storer, a saying prevalent among old-time Massachusetts fishermen is, "When you catch a goosefish, look out for an easterly storm."



The monk seal, *Monachus tropicalis*, the only pinniped indigenous to the Caribbean Sea, other parts of the West Indies, and Gulf Coast of the United States, is a rare, little-known species that is on the verge of extirpation. The drawing is based on a specimen in the U. S. National Museum, No. 13950, obtained by Professor Felipe Poey, at Matanzas, Cuba, almost 75 years ago.

"Sea Wolves" of the West Indies

By ROMEO MANSUETI

Illustration by the Author

WHEN, on his second voyage in August, 1494, Christopher Columbus came to anchor near the rocky islet of Alta Vela, off the southern coast of Hispaniola, he did not know that he was the first white man to see the strange West Indian monk seal. He wrote dispassionately that several seamen landed and killed ". . . .eight sea wolves, which were sleeping on the sands."

A full 350 years passed before specimens of the seal reached the hands of professional zoologists in Europe. By 1850 the ranks of the monk seals were already so depleted that they were a "novelty" species to be discussed with the dodo and sea serpent. Today the West Indian monk seal is on the verge of extinction. Because it is the only seal that touches the southern coast of the United States, a number of conservationists and agencies, including the International Union for the Protection of Nature, have earnestly sought to learn more about it and to save this seal from extirpation.

Few naturalists are aware that the West Indian monk seal, *Monachus tropicalis*, is the only member of the aquatic meat-eaters known to inhabit the Gulf of Mexico or Caribbean Sea within the recent era. In fact, when amateur naturalists and aviators observe it. they believe that they have discovered some relic of the Ice Age, or a semblance of a mermaid.

The animal is relatively nondescript in appearence. resembling its relative, the Mediterranean monk seal. another species that also has almost been decimated by man. Externally, the American monk, or hair. seal is a nearly uniform brown, tinged with gray, caused by the hairs being light at the extreme tip. It is lighter on the sides, and is pale yellow or yellowish-white on the bottom surface of the body. Adult males are a trifle smaller than females. The "monk" portion of the common name is derived from its scientific appellation, *Monachus*, which refers to its partly solitary habits, rather than any simian countenance.

Despite extensive exploration and zoological investigation of the West Indies, little is known of the extent and location of the monk seal's home. Glover M. Allen, in his *Extinct and Vanishing Mammals of the Western Hemisphere*, maps the geographic range as the Gulf of Mexico and Caribbean Sea to at least as far south as the coast of Honduras, and eastward to Jamaica, Cuba, and Hispaniola, and northward throughout the Bahamas. The many Seal Keys, and perhaps too, Sale Keys and Lobos Keys, are place names reminiscent of the former presence of these seals, or "sea wolves."

Early West Indian travelers had a tendency to exaggerate the numbers of the spectacular beasts that they encountered. And yet there is no reason to doubt that the West Indian monk seal was not an abundant species. The Indians have not left much of a record of how it figured in their culture. In pre-Colombian times, Dr. Raymond M. Gilmore, in his *Fauna and Ethnozoology of South America*, states, however, that "The monk seal. . .of Antillea, now nearly extinct. probably was utilized by the aborigines, but apparently no information on hunting techniques and uses have been recorded, although the Spaniards used the seal for leather and oil."

The romantic and quaint accounts of the early writers are the only reliable index to the relative abundance and utilization of these animals. Sir Hans Sloane, writing in his *History of Jamaica* in 1707, declared that "The *Bahama* Islands are filled with Seals: sometimes

Fishers will catch one hundred in a night. They try to melt them, and bring off their Oil for Lamps to the Islands." Some time earlier, in 1675, Dampier found them abundant at the Alacranes Island [Alacran Reefs], about 75 miles north of Yucatan. He added that ". . . the Spaniards do often come hither to make Oil of their Fat." Englishmen from Jamaica also came for the same purpose, and one Captain Long is mentioned especially for being caught in a heavy north wind, nearly losing his vessel, which was blown ashore. He later succeeded in repairing it, however, and ". . .filled all his casks with [seal] oil."

Some idea of how these seals could have been so easily reduced in numbers is suggested by their behavior. The story recalls the tragedy that befell the dodo, passenger pigeon, and other species. The animals themselves seem to have been remarkably sluggish and unsuspicious, allowing men to come among them without great alarm. Consequently, they were easily killed. Undoubtedly, it is this lack of fear and suspicion that has been their undoing. During the ceaseless slaughter that took place over the span of two centuries, no effort was made to learn the basic rudiments of the natural history of the monk seal. Dr. Allen remarked that, "From what little can be gleaned from the few observations made it appears that the young are born in the first part of December, for several of the females killed by Ward's expedition to the Triangle Keys had each a fetus nearly ready for birth." Of various stomachs examined by Henry L. Ward, an early American museum collector, and founder of the Wards' Natural Science Establishment, none contained identifiable food.

Reports of the monk seal continued to appear during the mid-nineteenth century. Phillip H. Gosse, in his *Naturalist's Sojourn in Jamaica*, pointed out that, at least up to 1846, there was a small colony at a reef known as Pedro Keys off the south coast of Jamaica, where he saw as many as five seals hauled out by sealers. After this, reports declined, but in 1875, two seals were seen near Cape Florida. Joel A. Allen, in a monograph on the monk seal published in 1887, stated that it was said ". . .to be found in great numbers at some islands [Anina Islands] situated between the Isle of Pines and Yucatan." At that period they were exceedingly rare on the Florida coast, but still occasionally seen in the Bahamas. "Their presence at Salt Key Bank, between Florida and the Bahamas, as late as 1868-69 is attested by information received some years since from the late Count L. F. de Pourtales." In 1883, one was captured near Havana, Cuba. No doubt the Seal Keys, a little southwest of Turks Island, were a former haunt.

The last stronghold of the monk seal during the last 75 years seems to have been the Triangle Keys, a group of low, sandy islets to the west of Yucatan. In December, 1886, Henry L. Ward, accompanied by the naturalist-in-chief of the Mexican Geographical and Exploring Commission, found seals in considerable numbers. Bad weather prevented them from staying more than three days, but they killed no less than 49, of which only 34 skins and seven skeletons could be preserved. In more recent years, however, the fishermen have not reported seals from this group of islands, although in January, 1911, some fishermen visited the Triangle Keys and killed about 200 seals, leaving, as they said, ". . .muy pocos vivos" [very few alive]. George F. Gaumer, author of a book on the mammals of Yucatan, believed that these fishermen must have nearly exterminated the animals.

Naturalists have been encouraged by the new records of the monk seal that have cropped up now and then. In March, 1922, one was killed near Key West, Florida. The president of a Pensacola fish company wrote to Dr. Francis Harper, an eminent American naturalist, that on numerous occasions prior to 1936 fishing vessels had brought these seals into port alive. The observer stated that in 1915 six seals were held in one of the bayous of Pensacola for a long period of time. Bathers seriously objected to their presence, after which they were finally released. Even then, they remained in the Bay for awhile thereafter.

Dr. Gordon Gunter, the well-known marine biologist from Texas, reported a number of sight records of the monk seal from the Texas coast in a 1947 issue of the *Journal of Mammalogy*. In 1932, several seals stayed for a six-week period near the jetties of Bolivar Pass of Galveston Bay, crawling out on the rocks and exciting much comment among observers. At Brazos Santiago Pass, during the same (Continued on page 500)

Open Season

By

EVELYN GRAHAM WILDMAN

Because this land, our farm
Belonged to us
We thought to keep from harm
The wildings here.

Best of them all, we loved the deer.
They knew no fear
And oft brought near the fawns
To jump stiff-legged in their play
At silent dusks or rosy dawns.

And so this trust
Was their undoing.
Hunting pressure, greed and lust.
Politic wooing.
Ungrounded reason.
Urged the fray called "open season."

Our hearts bleed with the land tonight
Though guns are through.
And now we know that arms are might
Sometimes at home here, too.

But with this grief
Is our belief
That God is sad as He looks down
Upon this creature desecration
Wrought in name of conservation.

4-D in Biological Education

By E. LAURENCE PALMER

This is the seventy-eighth in NATURE MAGAZINE'S *series of educational inserts.*

Three Infinities

Far as my eyes can reach there are stars and stars,
Nor may the widest lenses find
The awful outpost guarding at the bars
Where no stars lurk beyond.

Out at the farthest reaches of our sight
A myriad nebulae move fast,
A myriad universes in the night,
Intolerably vast.

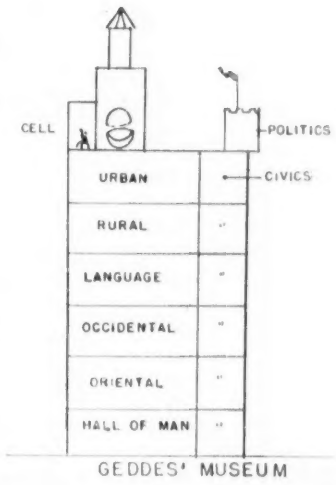
Deep in the hidden atom's sounded cell
Forces divide and subdivide
Beyond the power of any glass to tell
What clashing shapes collide.

In inconceivable minuteness they
Work their strange work and live and die,
Poising a balance in their own sure way
To the yet unprobed sky.

The mind of man undaunted measures these,
Suns, atoms, in unending flight,
And growing like the things it knows and sees
Also is infinite.*

MY FRIEND and one-time neighbor, Martin Sampson, now long since gone to his reward, expressed in the above verse his views on the subject of this special insert. I cannot hope to match his simplicity, or his effectiveness. In the July, 1954, issue of *American Scientist* Dr. Harlow Shapley expresses his views through an article "Cosmography: an Approach to Orientation." I have no intention here of attempting to duplicate his proposal for handling the subject in a program for general education at the university level. In certain details I differ with both gentlemen, and with others dealing with the general subject, in part, of course, because I write for a different audience and for a different purpose.

Possibly the major value of proposals of this sort lies in the fact that they stimulate criticism. I hope that this effort of mine is no exception, even though those criticisms may not find expression in written commentaries. If this attempt provides a pattern for discussion, as well as a stimulus for the same, it will have served its purpose, in part at least. There is no likelihood whatever that every reader will agree with all the details here proposed. Were I again to attempt to orient my views on the subject I probably would modify some details.



GEDDES' MUSEUM

Instead of Sampson's "three infinities," I here propose that we think of at least four. These may be four dimensions, giving us the 4-D of the title. At least one of these could readily be broken into one or more mutually exclusive units.

Roughly it seems that any attempt to classify our knowledge of existence might be assigned to four categories, some of which certainly are not mutually exclusive.

There will be those who will say that this attempt to classify knowledge, or aspects of the universe, is wholly inadequate. Whether it is juvenile or profound will depend on the viewpoint and background of the reader. It is not written as a challenge to the ablest thinker, or as a sop to the moron. It may fail in its attempt to be helpful because it does not go all out to meet the needs of either of these audiences. Possibly, because of this attempt to follow a middle of the road path, it will not be of maximum usefulness. However, it is an attempt to help crystalize some of the thinking that has been done along similar lines.

The late Patrick Geddes, author, with Sir Arthur Thomson, of *Life: Outlines of General Biology*, once lay on his stomach in my living room and sketched for me his outline, which he hoped some day to express through a museum. I submit here a tracing of his sketch. He felt that his museum should have seven floors, representing the growth of man through time. His outline obviously dealt primarily with the growth of civilization. His first floor was to be devoted to the evolution of living things, up to the appearance on the earth of Man. Succeeding floors dealt with Oriental civilization, Occidental civilization, the growth of Language, of a land or pastoral economy, of an (Continued on page 480)

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THE FIRST DIMENSION

Chief Factors	Elaboration
FUNDAMENTAL OR BASIC MATTER **Fundamental Particles** **Electrons, protons, positrons mesons, and so on** **Atoms** **The Elements**	Investigations into the nature of fundamental or basic matter have yielded and will yield facts probably causing the most profound changes that modern civilization has ever experienced. Since the ultimate in understanding the minute is not now, and may never be, understood, we choose to represent it by "????". Familiarity with the atomic world is being rapidly forced on a public only vaguely familiar with the Periodic Table.
MIXTURES AND COMPOUNDS **Molecules** **Molecular Systems including Crystals and Colloids**	Since the units selected for consideration of basic material appear in an order representing increasingly complex groups it is obvious why molecules follow atoms and precede molecular systems.
AGGREGATIONS **Inorganic Aggregates of Colloids and Crystals** **Minerals** **Rocks** **Meteorites** **Organic Aggregates** **Plants** **Animals** **Plants and Animals** **Organic and/or Inorganic Aggregates** **Machines Designed to Use Energy** **Using Cosmic and Gamma Rays** **Using X-rays and Ultraviolet Rays** **Using Light Rays** **Using Infrared and Heat Waves** **Using Power and Light Waves** **Using Sonic Rays** **Using Chemical Energy** **Using Magnetic and Electrical Energy** **Used in Energy Transfer** **Ecological Units**	Much as molecules are aggregations of atoms so aggregations of molecules may be brought together as colloids without definite chemical formulae, or as crystals with definite structure and chemical formulae. In Nature we may recognize some of these as minerals, including such a common form as water. These minerals may include, or be closely associated with, other minerals to make such combinations as rocks. These combinations vary greatly from simple mixtures, the parts of which may be separated simply by gravity, to mixtures, the parts of which may be separated by heat, by chemical action, by magnetism and by other forces. Man may create machines designed to use various forms of energy to attain various ends, or Nature may have evolved machines, such as plants or animals, capable of carrying on such important processes, for example, as photosynthesis. The plants and animals may make various associations and these may be closely identified with the physical environment to form more or less definite entities. An atom is a complicated structure, but is an entity. The same may be said of a horse or a forest.
SOCIETIES OF ORGANISMS **Societies of Common Ancestry** **Societies of Common Needs** **Societies of Common Environment** **Microclimatic Societies** **Macroclimatic Societies** **Megaclimatic Societies** **Societies, Opportunism and the Times** **Unorganized Societies** **Dominated Societies** **Self-governed Societies**	It is difficult to think of almost any ordinary living thing that might not in a way be considered a society of organisms. Most plants and animals may appear superficially as entities, yet they may well be dependent on the satisfactory functioning of many organisms. Bacteria may help in digestion within an organism, or fungi may serve as root hairs for trees. The health of a human being may depend on a satisfactory intestinal flora. We are here concerned more, however, with the integrated efforts of many organisms and studies of how these loosely or closely associated groups function as units. If we can recognize the ties that bind these units we may increase their usefulness to us or, if desired, can cause their disintegration and destruction. The whole field of sociology comes into our picture here if we can interpret it broadly and recognize common elements that are factors in societies large and small.
THE WORLD AS A UNIT **The Centrosphere** **The Lithosphere** **Land Masses** **Topography** **Subsurface Lithosphere** **The Hydrosphere** **Ground Water** **Fresh-water Areas** **Marine Areas** **The Atmosphere** **Lower Atmosphere** **Upper Atmosphere** **Stratosphere** **Satellitic Entities** **The Moon** **Meteors**	Adequate biological education calls for at least some understanding of the world as a unit. This should represent something more than the ability to parrot such words as centrosphere, lithosphere, hydrosphere, atmosphere and stratosphere, although any well educated person should have appreciation not only of the existence but of the nature of these areas. Space ships as realities and space ships in the comics challenge the thoughts of young and old, and the nature of the interior of the earth may affect survival of life on the earth more than all that goes on in the skies. For the most part, however, it would seem that, in the long run, the most substantial progress would come from understanding better than we now do some commonplace phenomena such as the tides, ocean and other underwater currents, tidal sequences as they affect life navigation, and other things.
THE UNIVERSE **The Solar System** **The Sun** **The Planets** **Meteoric and Satellitic Systems** **Stars, Star Families and Star Clusters** **The Universe**	We are concerned here with an approach to a reasonable understanding of the extra-terrestrial universe. Some of the units recognized in this area are suggested in column 1, but the astronomer, the physicist and the mathematician may elaborate phenomenally the elementary units we have presented. Obviously we do not, and probably never may know, the ultimate nature of space, and of materials to be found in space, but any reasonably intelligent person should have some basic knowledge of the field.

STRUCTURAL ASPECTS OF MATTER

Practical Aspects	Educational Aspects
World competition for fissionable materials that may find use in the new atomic age will be accelerated as atomic power comes into use in war and in peace. The successive ages of manpower, horsepower, waterpower, steampower and electricpower brought no more remarkable readjustments in the ways of men than can be expected with the incorporation of atomic power into the everyday world.	Physical science has expanded understanding of the nature of basic or fundamental matter through exact measurement, inspired research and phenomenal prognostication and is giving us a mastery of the physical world not matched by comparable understandings in the affairs of men. Unless comparable understandings in the social sciences are forthcoming, civilization and education must face one of its most serious crises.
In World War II spectacular research by the Germans might have led to their creating an atom bomb had it not been broken up. They were working in the production of molecules of heavy water.	Recognition of the differences between mixtures and compounds, between crystals and colloidal substances, is essential to an appreciation of increasing complexity of basic materials presented.
Normally one does not find, in classifications of this type, that one can consider a machine as representing an entity in a series of increasingly complicated aggregations of entities. Yet machines, whether made by Nature or by man, bring together particular characteristics possessed by their elements and direct them to do a specific service. A rock may combine minerals, but so does a plant. A lever puts suitable materials into positions where energy is properly transferred. It may be largely or fundamentally a matter of degree when we compare a simple lever with an airplane, or a computing machine, or an automatically operated industrial plant. Criticism will be directed at the inclusion of machines in this table, but one can hardly logically claim that machines composed of inert inorganic matter are not to a degree comparable with organic machines, also fundamentally composed of similar material. If inclusion of machines in this table stimulates criticism, it must also stimulate some thought and thus justify its inclusion. Our major factor in our industrial civilization is a machine.	Studies in this area may be given undue emphasis in any educational program. The identification of rocks, minerals, plants and animals may be essential to an understanding of the physical world, but it is not the whole thing. Even some may object to the inclusion of plants and animals as a part of the physical world. They are, however, tangible, objective and as such may appropriately be considered here. The educated persons should have some concept of the factors that make up most common aggregates, whether it is a peat bog, a cranberry plant in the bog, the juice of the cranberry plant, or the sugar molecule in the juice. Recognition of entities, and how they are associated into larger entities between molecules and ecological societies, is the area here emphasized. Obviously this includes the major portion of the units given greatest emphasis in the general biology course. The inclusion of machines as entities, whether they are living or inorganic, may raise some questions, but it is hard to find a more appropriate section for their inclusion.
The factors suggested in column one should provoke profitable thought and discussion. Societies based on ancestry are well illustrated in pure stands of trees pure cultures of microorganisms, or great schools or herds of creatures of a kind. Again, societies based on common needs, such as food, may be represented by herds of herbivores, such as flocks of sheep and goats that have common foods and, possibly, common enemies. Societies based on environment may well be best appreciated by studying what goes on in microclimates to aid in understanding what goes on in larger units involving climate. In this sense, a forest as we see it is intermediate between the little forest of a single twig and great forested areas covering continental areas. Time may well affect most of these, and there may be an evolution from complete lack of organization through disciplined integration to disorganization and chaos.	Probably the greatest menace to world peace lies in the lack of progress in the field of social science, but this progress is impaired by at least two resistance areas. The social scientists seem as unwilling to understand the basic story of natural science as are the natural scientists to appreciate the importance of putting their findings to work through applying what is known in the field of the social scientists. Too many want to become leaders in a field without developing adequate breadth to assure good judgment. Because a man is a great atomic physicist does not give him necessarily great authority in social science, and because a man is a great politician, writer, actor, speaker or statesman does not necessarily qualify him to express the best judgment in the field of physical and natural science. Somehow, if our civilization is to succeed, we must meet this challenging situation safely.
This unit, of course, is basic geography and, as such, it touches the field of economics, of history, of citizenship, and to some extent of philosophy, if we attempt to interpret all the various situations suggested to us by the geographers. However, one may often find more significant information in the publications of the ecologist than in much that appears as geography. This area of human knowledge has been presented in too many ways to permit complete coverage here. Who is to say that the physicist may not contribute as much to the understanding of the real nature of the world as the stratigrapher, the paleontologist, the soil technician and the cartographer. Somehow and somewhere the well-informed citizen will find something of merit and something appropriate to his needs in the investigations of most students of geography.	In schools some of the problems that may need to be met in this category center around evaluating such things as planting crops according to the phases of the moon; using divining rods to locate water, minerals and other substances underground; consulting solarlunar tables to predict luck in fishing; taking too seriously much that is found in many almanacs; taking too seriously the possible calamities and the possible freedom from calamities that are preached by many who depend more on inspiration than on intelligent investigation by themselves, or by qualified students. An informed public, reasonably sensitive to the story of the changes that have taken place, and will take place in the earth, is more likely to be a happy public than can result from a public frenzied by calamity howlers or asleep because of ignorance or misinformation.
To the average citizen this area may be identified with the astrologer, whose teachings carried greater influence in the past than in the present, and yet whose influence has too frequently in recent times been taken seriously by those in a position to cause catastrophe. Hitler might be a case in point. It is certain that the time spent by some on the study of palmistry, mythology and astrology is not always well spent, and there is so much that needs to be known that we can hardly afford to waste time.	Earlier inserts in *Nature Magazine* dealt with the "Sky at Night." Certainly it is more worth while to know something of the magnitude, period and distance of stars than to know myths about them that so frequently pass as masters in the field of astronomy at the pre-college level. There is obvious cultural value in knowing what others believed in the past, but as a rule textbook materials at pre-college levels in astronomy are too involved, or too false, to make the contribution that should be made to the average citizen.

THE SECOND DIMENSION

Chief Factors	Elaboration
ENERGY AND THE PROPERTIES OF MATTER **Radiation** **Cosmic** **X-ray and Ultraviolet** **Light Rays** **Infrared Rays** **Heat Rays** **Microwaves** **High-frequency Waves** **Radio Waves** **Power Waves** **Sound Waves** **Macrorhythms** **Energy Sources arising from** **Molecular Nature of Matter** **Chemical Nature of Matter** **Gravity** **Energy Transfer**	While philosophers may, with some logic, argue that there may be no hard, fast dividing line between matter and energy, we here elect to consider energy as it affects matter subjectively, or to group it with a consideration of the properties of matter that obviously is subjective. In addition to asking some consideration for the nature of radiation, we ask here for at least an approach to understanding or knowing about some of the more important sources of energy. While suggesting a pattern for considering radiation, we elect to suggest, in addition to considering frequencies or waves of short duration, so far as time consumed is concerned, we also give some thought to rhythmic cycles of long duration due in part to movements of the earth on its axis, around the sun and otherwise. Consideration of the properties of matter are too important and significant to warrant the degree to which they are usually ignored in pre-college science programs.
SPACE AS AN ENTITY **Space as it Affects Individuals** **Concept of Parts of a Whole** **Concept of Relation of Parts** **Space as it Affects Groups of Individuals** **Kinds of Groups** **Density of Groups** **Extent of Groups**	An understanding of the simplest nature of space is essential. We are here concerned with an appreciation of this. Cells may be entities. Combined they make tissues. The tissues combined may make a plant or animal. Combinations of these organisms occupy still more space as societies. All of these expanding groups vary, as suggested in column one, and special problems arise as these groups get more comprehensive and more complicated. In most of these, space may be an important factor.
TIME AS AN ENTITY **Nature of Sequences** **Sequences Without Order** **Orderly Sequences** **Sequences as They Affect Individuals** **Sequences Without Order** **Orderly Sequences** **Sequences as They Affect Groups** **Without Order** **Orderly Sequences**	The past, present and future as it has affected, affects and will affect any physical part of our environment comes into the picture here. In some cases we can make a complete mastery of a sequence by setting conditions. In others, as in a life cycle, we can do little about some inexorable situations that will develop. Economically, farmers may be interested in hastening sequential change, such as fattening stock quickly and with a minimum of food and care, or we may be interested in delaying some of the difficulties of old age and extending our life expectancy and period of productiveness. The water cycle is rarely a continuous, repeated series of sequences. The life cycle of an animal or plant follows a more established pattern.
MIND OR INTELLIGENCE AS AN INTERPRETIVE ENTITY AND EXPRESSED IN BEHAVIOR **Senses Available** **Ability to Recognize** **Orderliness** **Association** **Interpretation** **Communication** **Significant Differences** **Symbols and Signs** **Pictures and Maps** **Words and Word Groups** **Alphabets** **Elementary** **Numbers** **Letters** **Units of Space** **Units of Time** **Units of Weight** **Advanced** **Geological Time** **Astronomic and Microscopic Units of Space** **Periodic Table of Atomic Weights** **Units of Energy Measurement** **Units of Value Expressed in Mathematics** **Educational Measurement** **Cooperation** **Use** **Mastery of Time, Space and Energy** **Management** **Generalization** **Hypothecation** **Experimentation** **Broad Interpretation** **Habit Formation** **Reasoning Ability** **Philosophy**	Much of the wealth of the world lies in mind or intelligence as a means of interpreting the environment. This involves not only the ability of a human being to learn, but, to a large part, his ability to recognize values in the intellectual gifts, if any, of those organisms on which he may rely for a living. With the coming of the machine age it is less necessary for men to understand how to get along with horses, but when horses were in general use men varied greatly in their ability to get maximum cooperation. A jockey, if successful, knows how to get the most from his mount. A farmer who knows how to handle cattle, poultry and other animals gets more from them than one who does not know them well. We are here, then, concerned with the study of the intelligence or mental ability of living things, including ourselves. Basic ability to sense things is of importance, and animals vary greatly in the senses they possess, use and develop. In the first column we have listed, with some degree of orderliness, qualities that may contribute to the use of mind as an interpretive entity, which may be expressed in behavior. In all probability one of the major weaknesses of much of our educational practices rests on the behavior that recognizes an obligation, not only to the present but to assure a better and happier future. An unselfish, long-range viewpoint may call for a higher type of intelligence than that to be found in some who may make phenomenal contributions in relatively limited areas. How selfish and unselfish interests may be joined for the good of all may call for a type of intelligence not so common as it should be, if we are to look to the future with any degree of comfort.

MATTER IN MOTION

Practical Aspects	Educational Aspects
While we try to present units for consideration that are mutually exclusive, this is not always possible, and, for simplicity's sake, we have occasionally listed as entities phenomena that are in reality merely examples of such a phenomenon as molecular nature. We have also elected, in the face of possible criticism, to include, under the heading of energy and the properties of matter, consideration of energy transfer and the machines involved in this. Some may prefer to separate some of these possible entities, and they, of course, have that privilege. In the development of this outline we have tried repeatedly to arrange units in possible order of increasing magnitude. Consideration of a machine that transfers energy under this system would logically come after recognition of the existence and nature of the energy involved. Of course, these machines will vary greatly with the nature of the energy being transferred. They will also vary in their efficiency in performing their function.	In examining science programs for use at pre-college levels it is obvious that adequate consideration is rarely given to the properties of matter, the understanding of which may be essential to understanding of the properties of groupings of different kinds of matter. Look through the texts for adequate and appropriate consideration of such properties as elasticity, ductility, adhesion and cohesion, malleability, plasticity, viscosity and with states of matter, with hardness, with fracture, and it will be noticed how frequently students are asked to understand involved studies of matter without first getting some mastery of its elementary nature. They are asked to appreciate wholes with little understanding of the parts. Often, too, the presentations are so involved that recognition of everyday examples of the phenomena being considered is not given. The nature of solids, liquids, colloids, gases, of crystals and amorphic substances, of melting points, of what is meant by mixtures, tinctures, solutions and so on may be involved.
Analysis and synthesis affect greatly the nature of any study. Many branches of biology may give too great emphasis to analysis and too little to synthesis. The concept of taking things apart and putting them together involves varying concepts of considering smaller or larger units of space. Here we must consider this as it affects individuals and groups, their heterogeneity and homogeneity, their density and extent, all of which are important in a rational viewpoint.	Growth is almost synonymous with life, and growth implies increased use of space and need for space. Cytology, histology, morphology, anatomy and ecology represent areas of biology based, in part at least, on space. The history of civilization is full of crises based on the demands of growing populations, influence and ambition demanding new places in the sun, new markets, expanding economies, and yet, while space may be infinitely small, it may also be infinitely greater than man and his intimate problems.
Planning for the mastery of our physical environment, or preventing it from mastering us, depends largely on ability not only to understand the present but to predict the future. Study of the past may be significant in predicting the future successfully. Patterns of sequences, whether they are life cycles, ecological cycles or economic or political sequences, are important to successful living. True, a series of types of weather may not continue on a fixed pattern, but there is some probability that a given pattern may be followed. It is important to all that they have some understanding of sequences based to some extent at least on time, whether this is a simple youth-old age, seed-time harvest, boom-bust or other combination.	The effect of time on individuals and on races of individuals has provided the basis for many important fields of biological science. In some of these we may establish understanding of a reasonably complete series. In others this will be impossible or sketchy. We can learn the essentials of the life history of a wheat plant and can change the nature of future generations of that wheat, but we cannot get a complete picture of how wheat has evolved through geological time. Our study of time then varies from what the husbandman can do to determining the future of the environment that provides him with a living, to demands on our finest intellectual powers in exploring and expanding what we know in phyllogeny and evolution.
Intelligence may be a two-edged sword in some cases. A horse may be trained to recognize and respond to a few words, and this makes it useful to man. If it did not have this intelligence many of the burdens it has borne for man would of necessity have been born by other organisms, possibly by other men. The whole story of communication may give us some understanding of the role of intelligence in mastering the environment. Men recognize that many fur-bearers use scent to interpret their surroundings, and so men, who may not themselves be able to detect the niceties of odor, may yet use scent to master the fur-bearer. The increasing complications of means of communication may be accepted as a partial index of intelligence. A dog, for example, can unquestionably recognize signs, words, groups of words and familiar surroundings, but it is doubtful if he can use an alphabet of any sort. Horses have been reputed to be able to spell and count, but it is doubtful if they are not being guided by more intelligent animals. Birds like crows can count the number of persons in a blind, but not too high. But none of these can use the symbols man uses readily in communicating about units of time, value, space and weight. Not all men can have any appreciation of the fact that, too frequently, we do not get the most from our mental ability. We may accept recognition of things as adequate accomplishment. Unless the succeeding steps are taken to include association, interpretation, measurement, management and so on, and unless this is checked and used to attain some further desirable goal, and unless it results in habits of improved behavior, we have fallen short.	Possibly the finest type of living may come from applying superior intelligence to the integration of the efforts of intelligent organisms to worthy causes. It may be true that "where ignorance is bliss 'tis folly to be wise" if all one seeks is personal happiness for the moment, but it would seem that greater happiness to the individual and to society may result where a heterogeneous group of intelligent beings join in attempting to improve the lot of all. Theoretically, at least, society demands the best from those with varied skills, varied interests, varied capacities, varied opportunities and varied satisfactions. The engineer, the teacher, the researcher, the technician, the critic, the laborer and the scholar all add their bit, and each gets his satisfactions in an area that the others might not welcome. It is here that the statesman should make his contribution and unite the intelligent cooperation of all. Education may do much to develop individuals who will get the habit of enjoying doing what must be done where and when it must be done for the good of all. This would be impossible in a community of organisms of low intelligence. It should reach the highest level of perfection in groups of high intelligence, disciplined to responsible acts and resulting in such devices as the codes used, for example, by telegraphers or the more advanced concepts used freely by scientists trained in the physical and biologic sciences. The collection of data, its interpretation, its verification and its use may, of course, in its simplest aspects be used by organisms of relatively low intelligence, but real mastery comes when the individual not only is able to make an intelligent interpretation of his times, and his environment, but when he develops the habit of doing this within the limitations of a conscience that recognizes the rights of others.

THE THIRD DIMENSION

Chief Factors	Elaboration
KNOWLEDGE FOR KNOWLEDGE'S SAKE **Understanding** **Intellectual Curiosity** **General Education** **Research** **Basic** **Amateur** **Helpers** **Technicians** **Engineers** **Directors** **Leaders**	Our first page of charts considered recognition of the existence of matter. Our second considered the subjective ways in which matter might be understood. Neither of these implied a purpose. Here we are interested in how these understandings may be put to use, and how they fit into functional living. We may recognize that matter exists as a reality. We may recognize its properties, but here we want to recognize why this is worthwhile. One of these reasons might be just to satisfy intellectual curiosity and simply to get knowledge for knowledge's sake. We might also be interested in this to round out our general education, or for advancing human knowledge through research activities.
MANAGEMENT, KNOWLEDGE FOR A PURPOSE **Techniques of Management** **Incidental Management** **Advocational Management** **Management as a Vocation** **Agriculture** **Commerce** **Communication** **Education** **Government** **Industry** **Medicine** **Transport** **Investigation and Research** **Leadership**	During the latest war many ordinary citizens trained themselves to do routine jobs essential to our success in the war effort. With peace, many found it fun to make things, using the skills they developed in the emergency. Some carried on these activities as mere incidents, or to gain independence of outside assistance in times of strained economies. Some built boats, bred flowers or dabbled in home chemistry as an avocation. But to many this background of experience might well have formed a basis for a vocation. Of course, all this did not spring from the war emergency, but vocations frequently are based on focusing interests and skills started incidentally, and it is possible that the happiest vocation may be one that uses largely basic interests.
UNDERSTANDING OF MATTER FOR PROFIT **Elements of Profit** **Available Resource** **Status of Resource** **Harvesting Techniques** **Processing Problems** **Transport Problems** **Marketing and Salesmanship** **Ultimate Use** **Nature of Resource** **Non Renewable** **Renewable** **Nature of Profit** **Immediate** **Ultimate** **Sustained** **Techniques of Profit Making.**	Profit, as here considered, should be broadly interpreted not only to include monetary returns but returns in satisfaction as well. It is hoped that it may also be interpreted to recognize profit-making as a legitimate essential of a sound social economy and not as a destroyer of, or a parasite on, the weak. Much as life to any living organism requires growth, so life to a growing social order requires profit. Without profit there could be no business expansion, no preparation to meet old age, or probable expensive crises, no help from the strong for the weak, no increase in productive capacity, in short little, if any, economic growth. The evils of the profit system lie not in making a profit but misuse of profit, and unwarranted increase in profit by the few to the disadvantage of the weak. Understanding the profit system is a part of wise use of the resources that may be available to us.
UNDERSTANDING FOR RECUPERATION IN A BALANCED LIFE **Role of Recuperation in Complete Living** **Physical** **Mental**	The complete life calls for periods of recuperation mixed with periods of effort. It is important to recognize this as it applies to our physical well-being, and as it applies to our mental activities. Sometimes the recuperative effect may arise from a simple change of area of activity, while at other times a radical change may be necessary. The cycle of work, play, sleep and growth seems to be in most patterns of balanced lives.
UNDERSTANDING FOR PURPOSE OF HELPING OTHERS **Teacher-pupil Relations** **Individual Differences** **Aims and Objectives of Teaching Program** **Content Organization** **Material Aids in Teaching, Texts, etc.** **Evaluation and Tests Evidence of Progress** **Administration and Finance** **Philosophy of Education**	Here is the realm of the teacher, the social worker, the nurse, and the other groups of individuals who, while making a living themselves, make a major contribution in improving the lots of others. Of course, the first step in such a field implies the desire to make the sacrifices and to put at least some personal ambitions subordinate to the services available to others. Satisfactory progress in this field is not attained by merely having the desire to help. There are recognized patterns of behavior that bring the best results. Some of the more important of these are suggested in the column to the left.
UNDERSTANDING TO MEET ETHICAL AND MORAL GOALS **Ethics** **Aesthetic** **Morality** **Religion**	Any program concerned solely with the mechanics of getting a living from a material world is in the long run futile. The mechanic may fashion materials into a superb machine, whether the mechanic makes an automobile or an army for a powerful nation. Unless that machine is used for the betterment of mankind it might better never be made. How we can develop a generation with habits that result in moral and ethical behavior is one of the major challenges of our age.

FUNCTIONALLY UNDERSTANDING MATTER

Practical Aspects	Educational Aspects
Basically any intelligent animal must have some understanding of his physical and biologic environment. This is essential to living. Some will have a more lively interest and want to know more than is required for survival. Still others may recognize merit in a well-rounded understanding, to assist in meeting probable situations that will arise. The general education viewpoint is in part built on this recognition of the value of a broad base on which to prepare for the great variety of demands that may be expected in a normal life. Research, in its many implications, may be considered as the climax in pursuing knowledge for its own sake. All aspects must be recognized.	The advancement of knowledge for knowledge's sake through the channels suggested to the left represents much of what is taught in the average school and college. Research in its broadest significance calls for encouraging the members of a great team of specialists to work together towards an agreed goal. The investigative habits of youngsters may be dulled by the routine disciplines of the standard school program, but eventually we must recognize the necessity of encouraging the amateur, who may make some startling contributions through unorthodox procedures. We must provide trained helpers, trained technicians who can use the helpers, trained engineers, directors and above all trained leaders.
Repeatedly we hear the statement that individuals are engaged in "getting to know the business." Knowledge is undoubtedly the basis of much success in managing anything, whether it is a farm, an industrial plant, a wildlife sanctuary, or whether it is advancing in a profession. Refresher courses for business men, for teachers, doctors, insurance agents are common examples of adding information to the equipment of a worker, to the end that he may increase his productivity, broadly interpreted. A common device used by educators in this field is the so called workshop, where teachers bring their background of experience to individuals qualified to help them grow in their chosen field. Improved management in any field may depend largely on successful marshalling of resources to attain an end.	A common comment is to the effect that it would be most unfortunate if everyone had equal skill, equal interests, equal ambitions and equal ability. We would all be seeking identical jobs with calamitous results. The guidance program that has grown in the schools may be valuable in directing individuals into fields where their gifts are appropriate to the probable opportunities they may have to find expression and satisfaction. It would be ridiculous for our school system to train all of our students to raise fish, to read Greek, to repair cars or dissect cats. Probably educators face few more important responsibilities than those identified with recognizing the need for guiding others into professional fields that may prove fruitful and satisfying.
Broadly interpreted, the elements of profit with which we are concerned are outlined in column 1 to the left. Conservation fits into this picture perfectly. Legitimate profit implies a survey of the resource involved to know what may be available, a recognition that there is a harvestable surplus that is more valuable harvested than not, understanding of efficient means of harvesting to relieve drain on the basic supply, understanding and application of efficient means of processing the material, of transporting it, marketing it and eventually of using it. It must be recognized that non-renewable resources differ in the degree to which they may be available to individuals, to societs, to a generation, and that each generation should try not only to live within the economy provided by the inherited resource, but has an obligation to increase and improve that resource.	To translate what has been said to the left, let us consider problems associated with commercial fishing. Expensive equipment for carrying on such an activity demands established knowledge that the desired fish are available, that they are available in sufficient numbers to warrant the proposed harvest, and that this harvest may continue long enough to warrant the investment. It implies that the fish to be harvested are not more valuable as food for more valuable forms of wealth. It implies that the fish will be so harvested that the supply will not be unduly injured in the process of harvesting so that their value to the consumer is lessened. It implies an available market and efficient transport between harvesting and marketing points. It also implies that the consumer will make a maximum use of the fish with a minimum of waste and spoilage. All this must fit into a picture that recognizes the right of succeeding generations to make a similar profit.
In New York City it is a standard joke that Navy men come ashore and frequently find recreation by taking their girls for a boat ride in Central Park. The typical "busman's holiday" finds its counterpart when business men play bridge for recreation, professional athletes take rugged vacation trips into the wilds, and professional dancers find recreation in social dancing. Recuperation is a varied feast.	With a successful economy we are gaining increased leisure. Wise use of this may be the most important contribution a science program can make, not only to solving some of the problems of juvenile delinquency, but of extending the period of productive happiness and improving the depressing conditions that may accompany the reduced physical and mental powers that come with old age.
While there are proved patterns of procedure that may be expected to yield superior results, teaching and similar services call for something beyond the mechanics of pedagogy and involve something of the art of education and of teaching. Teacher and pupil differences must be adjusted, individual differences recognized and the other categories, suggested to the left, considered, but the mechanical teacher is as inspiring to cooperative effort as is the mechanical piano. We must have adequate finances and adequate administration to care for some of the chores associated with education, but more than these we must have honest, inspired, intelligent leadership.	It may be important to have intelligence enough to exist, to make a living, to make a profit and to plan a balanced life, but it is doubtful if any of these can carry the rewards that go with a life of service to others. In return for these services society should reward reasonably those who elect to devote their lives to such activities. Unfortunately success in this field cannot come past by running with the pack. Few fields of human endeavor are involved in more sinister, crackpot, lazy schools of thought than is education, and it takes the alert, courageous teacher to evaluate the suggestions offered him by others, and to plan a program that will satisfy his conscience.
Conservation has been defined as wise use, a definition that implies that use is necessary. It is aimed at a more or less mechanical pattern of behavior. Another definition is that it is man living in harmony with the land. This is a step in the right direction, but lacks the dynamics favored by many. The most recent definition that it is science with a conscience, or the conscience of science, may be what we are seeking, since it goes beyond use or even beyond harmonious use, and calls upon ethical and moral checks.	Ethics, esthetics, morality and religion must find some expression in an adequate program in education in any field in spite of what the mechanistic educators may have to say about it. True some educational programs have attempted to offer the shibboleths of religion as a substitute for understandings in science. This is as dangerous as the worst, cold-blooded, disciplined, goalless, mechanistic program. Somehow we must meld the good of all human experience into a program that helps people be happy doing what must be done for everyone.

(Continued from page 473)

urban economy. His top floor was a variety of towers and pits representing unevenness in progress in man's understanding of the world. He provided orientation by means of a device that would permit one to see where he was in the universe by looking in any direction, up or down, and he had a small tower, called politics, which was in part unsupported by any sound logic.

In the tables on the central six pages I propose that we examine three of the four aspects I am suggesting. The fourth is elaborated on this page of the insert.

As a possible alternative to Dr. Shapley's "The Material Systems," I suggest that we consider "The Structural Aspects of Matter," the details being provided on pages 374-375 deemphasizing some of Dr. Shapley's suggestions, and emphasizing some that he has passed over lightly.

On the fourth and fifth pages of this insert I suggest consideration of our second dimension, or aspect of the problem. There will be those who will contend that consideration of energy, time, space and mind cannot be grouped and that each should be treated as an entity. Since any of the factors suggested on any of these pages may be applied to all the factors suggested on other pages, there is nothing to prevent those who may wish to split the material from doing so. It seemed that possibly energy, space and time might well be considered as matter in motion, and who is to say that mind might not equally well be classified there?

Our third dimension, or viewpoint, of this whole subject centers definitely about man. It deals with the functional aspects of understanding matter, broadly interpreted. It provides man with a purpose, or purposes, for understanding the previously suggested dimensions. These purposes vary from simply mastering knowledge for knowledge's sake, to using it for personal advantage, to using it to help others, and to using it to make a better world in which to live. Most of the types of human activity should find some recognition in the proposed areas of consideration.

Education offers professionally some of the greatest possible rewards of life, but, like other rewarding occupations, it calls for a willingness to make sacrifices, to live an unselfish life, and to devote every effort to continuous growth and improvement.

Our fourth dimension might be set up on the following plan:

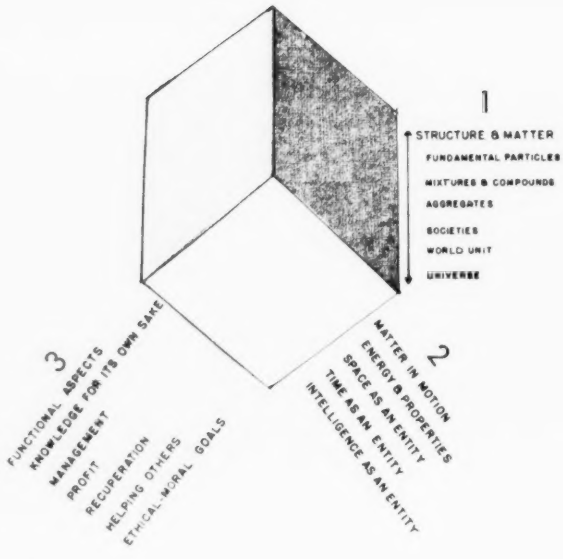
4th Dimension. The Growing Individual in His Environment

The Developing Individual
- Pre-school Experience
- Genetic Heritage
- Home Experience

School Experience
- Extra-curricular Experience
- Elementary School
- Secondary School

Higher Education
- Vocational School
- College and University

Post-school Experience



Possibly our graph or diagram suggests adequately the idea that at any age the individual human being may make some use of the ideas suggested in the earlier three dimensions, and that, so long as growth continues, life will have an expanding significance. In old age and senility, with the loss of the use of some of the senses, and with the loss of other abilities, there obviously comes a contraction.

Throughout the growth of the individual, from youth to old age, the teacher finds an opportunity for service. Possibly the joy of service in this field was best expressed by a former student of mine, Eleanor Johnson Bogan:

It may be I shall never pass
Down some queer, vivid foreign street.
Nor hear the temple gongs of beaten brass
Above the heavy tread of many feet.
Yet shall I be content with only this:
With every gentle, soft-returning spring
Down crooked lanes where tiny leaves unfold,
To go adventuring.
It may be I shall never see
A Chinese junk with purple sail,
Drifting upon a quiet, greenish sea,
Drifting beneath a sunset, cold and pale.
Yet shall I be content with only this:
To feel a little child clasping my hand,
To go adventuring in that child's heart,—
Some day, to understand.

PHOTOGRAPH BY LEE JENKINS

The mourning dove, a game bird in Illinois, was the subject of a battle before the Illinois Legislature in 1953. Hard-working volunteers nearly scored a victory for the bird, despite the barriers of both opposition and indifference on the part of many members of the Legislature.

*Mourn*ing Doves in Illinois

By MADELINE DOROSHEFF

Illinois is not a State noted for its conservation policies. Its conservation department suffers from politics, jobs changing with changing administrations. However, it is a pivotal State so far as the future of the mourning dove is concerned. The bird is on the game list and widely shot. In 1953 a drive was made to remove the dove from the game list and to extend protection to it. The drive came close to success, and would have succeeded had not too many legislators been afraid to record their votes. We asked Mrs. Madeline Dorosheff, who was in the thick of the fight, to write the story of the Illinois battle. She has done so in revealing and dramatic fashion.

DURING the stormy first committee-hearing on the dove-protective bill, an Illinois legislator exclaimed: "I thought the dove was a bird of peace!" Nothing else was peaceful about the ill-fated campaign of 1953!

Dove legislation in Illinois, seeking removal of the mourning dove from the game list, made abortive beginnings in 1949 and 1951. Neither effort got out of committee. This time, conservationists and bird enthusiasts determined to make a stronger stand.

Representative George A. Brydia, who introduced the previous measures, was approached to sponsor the new bill. He shied away; finally, refused.

"I hope you get someone else," he wrote, bluntly, "who will get a licking from the Conservation Department."

The Illinois Assembly meets for six months in odd-numbered years, sessions beginning in January. Almost a year before the 1953 Assembly, Audubon Societies and Nature groups started work, drawing up resolutions to support the bill. Three thousand persons signed petitions to "protect the doves." Some of these were people who hardly knew a sparrow from a robin.

"What doves?" they asked.

Upon learning the bird was the gentle "rain crow," there was an immediate response to outlaw dove-hunting. It was not so easy to find a legislator, who knew the opposition he must face, to sponsor such a bill.

In April, three months after the Assembly convened, Representative G. William Horsley, of Springfield, consented to introduce the measure, which became known as House Bill 514. Mr. Horsley was a real "find." A vague resemblance to Lincoln (he plays the Great Emancipator every year in a reproduction of Robert Sherwood's *Abraham Lincoln* at New Salem) conceals a keen, analytical mind. Best of all, he is a man who will undertake unpopular causes, and slug heroically for them when the going gets tough.

Determined to back Horsley to the limit, workers assembled information on the present status of the mourning dove. It was easy to find glaring reasons for banning dove-hunting in the State.

From 1949 to 1951, the State Natural History Survey conducted a dove study. Harold G. Hanson and Charles W. Kossack reported the bird had decreased between 40 percent and 60 percent in two years. They recommended: "If there is any doubt as to how much additional protection should be given the dove, the decision should be in favor of the dove and not of the hunter."

This report brought no action to limit hunting.

In the Southeastern States, a 10-State cooperative study found the annual mortality of doves to be 70 percent. "The present rate of reproduction is not keeping pace with the staggering mortality figure," proclaimed a United Press release on March 29, 1953, "and wildlife experts fear the dove may be headed for extinction."

Despite the questionable situation affecting the mourning dove, open seasons on these birds have been increased in Illinois and Missouri for the 1954-55 season from 30 to 35 days. This is the decision of the U.S. Fish and Wildlife Service announced by the Department of the Interior. Elsewhere dove shooting regulations also have been relaxed.

Don Allison, a leader of the project, advised, "At present, hunting is the only mortality factor which can be controlled."

In Illinois, at least, Nature-lovers were sure this suggestion would go unnoticed.

H. Elliott McClure, dove authority, contacted by letter at his Army post in Japan, repeated his earlier conclusions: "Protecting doves north of the 37th parallel would give them some chance of survival. In a State as populous as Illinois, the hunting pressure must be terrific. Illinois would do well to protect the mourning dove."

His studies had convinced McClure that dove-shooting in the northern half of the United States strikes at the bird in its breeding grounds, bad practice biologically and for humane reasons.

Milton Thompson, Illinois ornithologist, in an article deploring the hunting of mourning doves, went even further. "A robin," he stated, "would make a better game-bird. It produces twice as many young of about the same size, with a far better survival rate."

His reasoning was based on the doves' life history. They lay only one or two eggs at each nesting, on a flimsy structure, easily destroyed. Young are fed by parents for about two weeks on a secretion called "pigeon-milk." Starvation threatens the young if either parent dies.

This is why doves cannot be artificially propagated, like pheasant or quail. Survival depends entirely on the slow process of natural reproduction. Harassed by weather, hunters, and its own limitations—small wonder doves had declined!

These arguments, it was hoped, would move the committee to recommend complete dove-protection. Workers prepared folders, containing this and other information, for the committee-hearing.

Bill Horsley was more practical. "Bombard your legislators!" he advised. He knew, with bills piling high, the most convincing logic to a law-maker is a postcard from home. An avalanche of mail, from representative areas of the State, will put across nearly all deserving bills.

Guy Atherton, of Minnesota, the dean of dove-protective legislation, declared, "Horsley is right, and there are more Nature-lovers than hunters. Go to it!"

Acting on these directives, Chicago Audubon workers channeled stories into the *Tribune* and the *Sun*. Springfield papers carried editorials. Weekly newspapers received press-releases. Garden Clubs and the Farm Bureaus received notices.

With slender funds, and a limited number of active workers, promoters of the bill did their best. On May 20, when the Committee on Waterways, Conservation, Fish and Game met, they could only hope their best was good enough.

In the little committee room, high up under the eaves of the State Capitol, it was hot and stuffy. Six weeks of the Assembly remained. The atmosphere was tense with unfinished work and heat.

Bill Horsley rushed in from another committee meeting. He looked wilted but ready for another "fight."

"Had four of 'em already, today," he explained, mopping his troubled brow. "All set?" he asked. "Loaded for b'ar!" grinned Stanley Atterberry, Springfield Nature League president.

Members of the committee drifted in to take their places at two long tables. A worker for the bill placed mimeographed folders at each place.

"Hey, where you going?" called a committee member to a retreating colleague. "The bird bill's coming up!"

"I know," answered his friend, but continued toward the door. Horsley stopped him:

"Can you give us a vote for the dove bill?"

"I said I would," confessed the squirmer, without enthusiasm. "The chairman's got it."

More than one committeeman had pressing business elsewhere to avoid going on record for or against the doves. Those who remained, settled into their chairs, glancing casually at their folders. Visitors filled the little gallery.

When the bill was called, Mr. Horsley made a skilful presentation of its intent. As a non-member of the committee, he could only speak for it in his introduction. Then he called on Stanley Atterberry.

This tall, earnest young man gave a straightforward plea. As he finished speaking, one of the committeemen moved to advance the bill to the floor of the House. For a moment, the battle seemed won.

"No, no," cried others. "Let's hear from the hunters, now. Let's hear from the Conservation Department."

Lew Martin, assistant director of the Conservation Department, rose with experienced aplomb to present "the hunters'" case. They were not, he said judiciously, against protecting the dove where necessary, but in spite of continued hunting, twenty counties had reported an increase of birds.

"What counties?" queried a committee member.

"I don't know," admitted Martin.

"However," he continued, shifting the defense, "by the Federal Migratory Bird Law, the dove is declared a game bird, and that," he added, virtuously, "is good enough for us."

A woman listener, stung by the assistant director's weak argument, jumped to her feet, was recognized, and tried to appeal to the humane instincts of the committeemen.

"It gives me darn good target-practice, though," smirked a law-maker, in answer to her impassioned plea.

Horsley, by committee rules, could not add his skill to the wavering cause. At this moment, one strong, authoritative voice might have swung committee sentiment. That voice did not speak. Amid calculated hub-bub, a member proposed referring the bill for two weeks to a sub-committee.

"Gentlemen," expostulated Horsley, "two weeks' delay will kill this bill."

"All right—one week." The committee voted and hurried out. Bird-lovers gathered up the pieces of a shattered cause and clustered around Mr. Horsley.

"A dirty trick," he muttered. "All of you be back next week."

From now on, it was a matter of what influences could be brought to bear on committee members to vote the bill out.

"Watch out for delays," cautioned a seasoned well-wisher.

At the second hearing, a member of the sub-committee asked for another week, "to see some people." The chairman advocated giving a second week. The motion passed. Aghast, a State official later exclaimed, "You should have booed the committee!"

Horsley grated, "There's going to be some fireworks around here!"

At this point, reenforcements by way of mail expression, were needed from all over the State—not just a flutter of cards, from a few areas, but a "bombardment" as Horsley expressed it, from all sections.

Friends of the bill strove valiantly to acquaint constituents with the necessity of getting word directed to the legislature.

On the eve of its third hearing, the Conservation Department "dined and wined" members of the legislature. A lavish display of hospitality and hilarious hi-jinks enlivened the banquet. The party was acclaimed in a local newspaper as a huge success. Next day, not a committee member appeared for the scheduled hearing!

Now, really aroused, Horsley took the measure away from the committee to the floor of the House. A vote of 81 to 19 put it on the calendar. It would be heard.

At the same time, an identical bill was having its ups and downs in the Senate. Normally, an uncontroversial bill that passes either House gets by in the other one. Usually, it is considered duplicated effort to work on identical bills. However, mixed signals, among well-meaning persons, had resulted in this situation.

Senate Bill 406 came up for vote on Thursday, June 18. With public expression still weak and uncertain, the vote was a striking example of Senatorial courage. There were 18 votes for it, 21 against it, 10 Senators abstaining. Under the majority rule, five more votes would have spelled victory.

Next day, in the House, the weary bill took a final count. Horsley spoke for it. With the let-down of the end of a gruelling six months, other legislators joined in the relief of wise-cracks.

"A vicious bill," said one, "trying to change a game bird into a song bird."

"Why, someone might as well introduce a bill to change the sex of Mr. Horsley," beamed a "wit," amid appreciative titters.

Twinkling light-bulbs on the balloting board recorded the "ayes" and "nays." Like the beating wings of a bird in flight, the dove's chances rose, and fell. When roll-call was over, 46 had voted for outlawing hunting, 45 voted to continue it, 60 did not vote. The bill needed 31 more votes to pass.

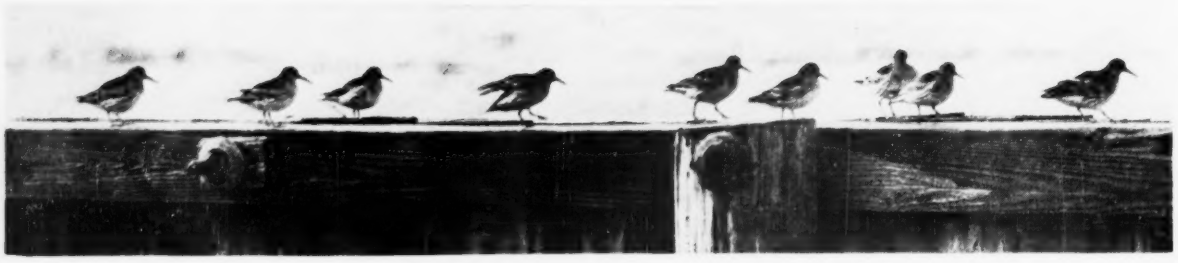
A wise conservation measure in Illinois was temporarily delayed. The people had spoken through their legislators. What of the 70 Assemblymen who did not vote? Were they uncertain as to the public wish?

When the people care, they can have any conservation measures they want. Public opinion makes the laws. Will they care enough, in time, to protect their vanishing wildlife in Illinois. . . .and other States?

The Mist and the Me

By MICHAEL G. SHRINER

Feathers and foam
And a misting dawn
And a long, lone stretch of sand
A fog drenched sea
And only me
And a gull at the edge of the land



Parade of the purple sandpipers.

Tybee's Purple Sandpipers

By IVAN R. TOMKINS

Photographs by the Author

ON TYBEE Island in the mouth of Georgia's Savannah River there are groins of wood and steel that reach out from shore a hundred yards. They were built somewhat less than twenty years ago, on the site of other such structures, to break up the along-shore currents that tend to erode the beach. At the shoreward end are heaps of various surplus rubble, one-man rocks, broken concrete, and the like, placed to aid the groins. All these furnish a habitat similar to that of a rocky shore, something lacking naturally on the ocean beaches of our south Atlantic States, beaches that have recently built up from old sea bottoms outside of other ancient shore lines. This habitat contains much marine growth, barnacles, limpets, oysters, and algae, and it furnishes shelter for the more mobile crabs, worms and the like.

All up and down these beaches, on the saline mudflats and the salt marshes behind, and in the shallower waters of the shore front, tides of birds eddy and flow. There are many species and a great number of most of them. To the groins lately have come the purple sandpiper, normally a winter resident of the rocky New England coast and not previously known to be a regular winter bird south of New Jersey, or, perhaps, Maryland.

To the field student of birds, the amateur I mean, there is high exultation when a species or subspecies is found that has not previously been known from the locality. Possibly such an incident may not be of too much importance if it is just an accidental occurrence, yet sometimes the happening opens a view that leads to knowledge of significance and a fresh outlook on bird migration and distribution. Such was the case when I found the first purple sandpipers resting on the north end of the island. For many years I had been hoping to find at least a single bird of this species, but, thinking the long rock jetties of the Savannah River entrance a mile or so to the northward was the logical place, I had neglected these beach works. A few years ago these birds had been found on the jetties of Charleston Harbor, a half-State to the northward. But scanning the Tybee jetties had been neglected because it meant some miles in a small boat. Such a trip to this exposed locality, even in our usually mild winter climate, would almost always be wet and often cold and raw, and could not be done at a moment's notice. Besides, salt spray is hard on cameras.

Ruddy turnstones, associates of the purple sandpipers, take off to fly out over the water in search of food.

However, finding the first purple sandpipers set off a search, and more were found on the groins, feeding with the ruddy turnstones, a few sanderlings and a least sandpiper or so. Later visits proved that the purples were settled for the winter. After a time a single bird was found on the south jetty, but the main group did not frequent that

Heads pop up from crevices among the rocks.

place. Had I neglected the near at hand, and had the species been coming to the groins for some years? Perhaps so, but at any rate no one else had found them. My friend, Sam Grimes, who lives at Jacksonville, Florida, heard of the find, and made some dangerous trips out on the jetties at the mouth of the St. Johns River, and finally saw one bird.

Why had this bird moved such a distance from the range we knew? Certainly no one cold spell, or even one cold winter, would drive them such a distance, assuming that cold weather ever causes a species radically to alter its migration. And it is not reasonable to expect the birds to fly off so far just to find one favorable spot. The dovekie, when driven into New England from the sea, seems to have continued on south instead of swinging back to the normal place, but this is a cataclysmic happening and the birds do not return. Could there have been an ancient migration path unknown to ornithologists, and followed by a few unnoticed purple sandpipers that had here found a place to their liking and stopped off, an unsuspected facet in the regimen of the species? If so, where does this population spend the summers? Is it a fragment separate, or a sympatric species, a part of, but biologically separate from its neighbors? These thoughts are never possible of complete answers, but they are the warp and woof of every ornithologist's method and way of thinking.

The purple sandpiper breeds in the Arctic of the Old World, and westward across the Arctic of the New World to about Longitude 118 degrees. Then there seems to be a gap, although a related form breeds in the Pribilof Islands and migrates along Pacific shores. Whether there are some breeding in this gap apparently is not known, according to the authorities at hand.

The day after Christmas, 1949, was the day the first ones were found, and they have been present in numbers every winter since, arriving in November or December and leaving in late March or early April. A single bird seen in September was probably an individual that failed to make the spring flight. Five winters of known occurrence is good evidence for considering the purple sandpiper a permanent winter resident. Five winters, with numerous counts of those seen, may, by later comparison with other series of counts, indicate whether the species is gaining or not.

No other shorebird I have known feeds so like a butterfly. These sandpipers will often fly out over the water, or the sand, and flutter along the vertical walls to pick choice bits of food. Otherwise they run in and out as the swells come in, or feed on top of the whalings, often where the spray is plentiful. Algae furnish most of their food here, supplemented with small gastropods, bivalves, marine worms, and such.

A cold northerly wind in town, twenty miles away, is likely to come right out of the northeast at the beach. When the water covers the groins and is raw and cold, the purples and the turnstones are prone to search out hiding places in the rocks nearby. Or they may gather in small, compact flocks and walk far enough back in the small dunes to find shelter. When it is cold and windy they are reluctant to fly and will let one walk quite close. Then the photographs that seem impossible in fair weather are relatively easy.

One day there appeared the rarity of rarities, a semi-albino. It was so light that, at a distance, it resembled a winter sanderling, but a close-up view showed it for what it was, a purple sandpiper with many all-white feathers. I walked within twenty feet, and was certain of the identification. Over the years, the shorebirds seen would certainly mount into the millions, literally, for flocks of a thousand or two is a common sight, yet I can remember only one other albinistic bird, a Wilson's snipe, which had no black at all, but was simply brown and white. Probably this last should be called a color phase rather than albinistic. The purple with the white feathers was not again seen.

The happening of the purple sandpiper gave much interest to many field trips, and there are things yet to be done, and beyond them will still be others.

"And the verse of a Lapland song is haunting my memory still, 'A boy's will is the wind's will, and the thoughts of youth are long, long thoughts'." May our youth be long!

Beetles Brought to Banquet

By BOB FORBES

Photographs by J. K. Holloway

The shiny black beetles from abroad have just about finished eating up the plant of the pestiferous and noxious St. Johnswort, which has ruined so many acres of grazing lands.

ENTOMOLOGISTS are celebrating this year the one-hundredth anniversary of the profession of economic entomology in the United States. It was just a century ago that two insect scientists were first officially employed. In New York State Dr. Asa Fitch, a medical doctor, was named State Entomologist, and the Federal Government employed Townend Glover, assigning him to work in the Patent Office. There he prepared exhibits of insect life to the wonderment of the uninformed public, and concentrated his first interests on the pests of orange trees and cotton.

It was upon such small beginnings that scientific leadership in the control of insects injurious or beneficial to man's interests was based. Through the century past the army fighting the never-ending battle against super-fertile insect spoilers has grown, as have its weapons and its scientific knowledge. In the destruction of crops and fruits, in loss to raisers of livestock, and in diseases carried by insects, the annual toll of the insect is tremendous. It would be far greater without the control techniques of today.

One of the most interesting and dramatic phases of economic entomology is enlisting insect to fight insect. Thus were fruit orchards saved from destruction by the ladybird beetle's appetite for cottony cushion scale. Similarly, the entomologist has made use of specialized appetites of beetles, one example of which is the beetle that gorges itself on an undesirable-alien plant from Europe.

Known variously as goatweed, St. Johnswort and Klamath weed, this immigrant plant has spread over several million acres of our western range land. The plant is known to botany as *Hypericum perforatum*, and the most widely used common name is St. Johnswort. It originated in Ireland. This invader chokes out grass and is poisonous to livestock.

Despite his weed-killing machines and sprays, man cannot effectively fight such a plant pest over the tremendous area that it has appropriated to itself. Much of this area is mountainous backcountry. So the entomologist went into action.

Investigation showed that Australia is the only other part of the world where the goatweed has spread widely, although it is known around the world. But, in Australia, it was also found that there was a beetle that ate voraciously on this plant. In fact there were three species of beetles with this dietary habit, and ten years ago some of these beetles were brought here by the Bureau of Entomology and Plant Quarantine to the experimental station at Albany, California.

Study of the habits of these imported insects showed that the best performer of the three species used in original American experiments was *Chrysolina gemelata*. This beetle is all black and about half again as large as the black-spotted, orange-colored ladybird beetle that has proved such an insect ally. This ebony insect doted on the leaves of St. Johnswort. In fact, it was so choosy that it refused any other plant for food.

"Flying the beetles here from Australia had its difficulties," said Dr. J. K. Holloway of the California station. "Furthermore, we had to change our beetles' life cycles so that they could adapt themselves to seasons that are the reverse of those in Australia."

In view of this seasonal difference, a beetle in the United States would be active while the corresponding beetle "down under" would be inactive, and vice versa. To get around this, entomologists flew in beetle larvae in different stages of development, and held some in cold storage to be released at strategic times.

Meanwhile studies were made to discover whether the insects would nibble on valuable plants, also. This was essential before it was safe to release the insects in California, where at least 400,000 acres of grazing land had surrendered to an abundance of golden-blossomed but pestiferous weed. Finally, in 1945 and 1946, several thousand beetles were liberated in the infested fields. In several test plots it was found that, in one year, the hungry insects had gorged themselves on all the St. Johnswort within fifteen yards in radius of each release spot.

Above is an area of what was once fine California grazing land but which has been preempted by the useless and often poisonous St. Johnswort, or goatweed, or Klamath weed. This picture was taken in 1949, while at the left is the same field five years later and after the imported beetle had cleared it of the weed plants.

With such a start, the imported beetles made themselves at home in California. They thrived like natives and raised large families. Thus additional shipments from abroad were no longer necessary, and the descendants of the original immigrant beetles are busily at work on California's goatweed.

Oregon, also, has troublesome St. Johnswort on some one million acres. So Oregon State College, the State Extension Service and the Federal Government have cooperated to bring in California-raised beetles and release them. In southern Oregon in particular the insects have been increasing and are spreading over more and more of their adopted territory.

Overgrazing and fire have combined to aid in the spread of the weed so that it has claimed nearly two million acres of Idaho's range land. Six years ago some of the beetles from California were introduced to the Gem State. It was found there that a colony of 5000 beetles would increase during a five-year period and eliminate the weed on two hundred acres of range. The increase is not quite as rapid as it is farther south, but it is effective. Since 1948 Idaho has established about 370 colonies. Montana and Washington are also confronted with range lands infested with St. Johnswort, and are extending hospitality to the beetles, which originally came from Europe, as did the weed they dote on eating.

Thus the economic entomologist has scored another victory, one that has cleared up more than 100,000 acres of California's range land and promises to restore to usefulness the range in several western States.

The Birds' Clown

By
MARION DOYLE

The chick-a-dee
Is an acrobat,
A funny
Little clown.
He hangs upon
A weed or bough
And lunches
Upside down!

Living Color

By FREDERIC W. NORDSIEK

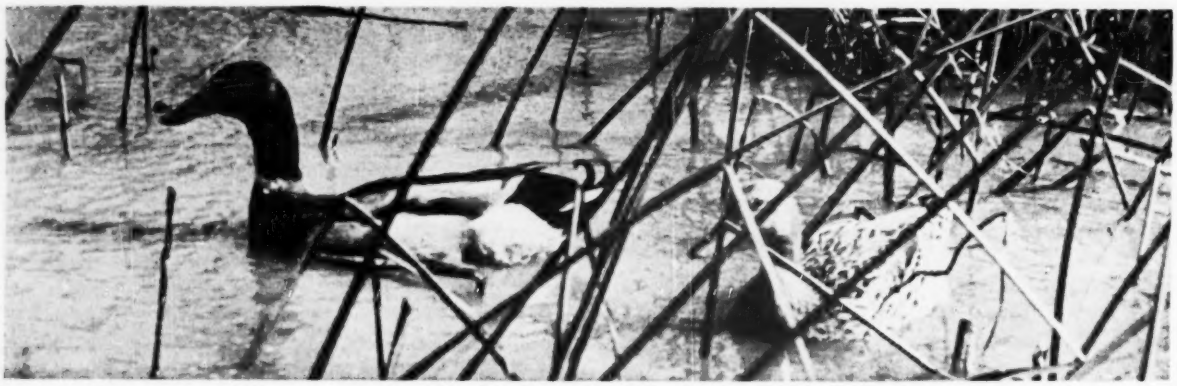
Vitamin A is important to animal vision. Within the animal eye, localized in tiny organs, is "visual purple," which is made by the animal body from carotene, or vitamin A.

THE splendor of Nature lies more in color than in form. Lush green of summer forest immeasurably surpasses in sightliness the monotone of winter woods. Black-and-white photographs of wild flowers do poor justice to their subjects, for the flowers' delicate hues are the basis of their beauty. The oriole and tanager, the sulfur butterfly, the red eft, all attract us by their flashing colors. But often the colors of plants and animals have importance far more profound than that of superficial beauty, for some of the pigments that give rise to such colors have indispensable functions in the living economy of the organisms possessing them. Hence, through the balance of Nature, in certain cases these pigments are invaluable to the welfare of the living world at large. And outstanding among vitally important natural pigments is chlorophyll, the green coloring matter of higher plants.

By the man in the street as well as by writers of literature, green is recognized as the dominant color of the natural outdoors. Hudson called his story of the Venezuelan forests *Green Mansions;* O'Donnell wrote of the Mississippi's teeming banks as *Green Margins;* Peattie recounted the lives of the great naturalists under the title *Green Laurels.* Green is, indeed, the color of the ubiquitous higher plants, found abundantly in most parts of the earth. Fortunate it is for the survival of living things, plants and animals alike, that green chlorophyll-bearing plants are so numerous, because green plants supply all of the food-energy used by living things. Living organisms require abundant energy for their daily functionings; for their very existence. All of the energy naturally available to the earth and its inhabitants comes from that fiery orb, the sun. But the energy of sunlight must be captured and imprisoned in foodstuffs before this energy becomes biologically useful to plants or animals. And only the green plants, through the medium of their magic chlorophyll, possess the ability to incorporate the energy of sunlight into foods.

Yes, ever since the dawn of its existence, the earth has drawn its energy from the sun. Coal and petroleum are mineralized prehistoric plants; when these fuels are burned to supply power, they yield energy that green plants took from the sun, by means of their chlorophyll, aeons ago, far back in geological time, The energy of water-power comes from the fall to lower levels of water that had been elevated into the atmosphere by the sun's heat. But neither coal, petroleum, nor water-power can supply energy physiologically usable by plants or animals.

To incorporate the sun's energy into foodstuffs, green plants begin by taking from the air carbon dioxide, or carbonic acid gas, containing the chemical elements carbon and oxygen, and by taking from the



Inability to distinguish sex could never be suffered by the brightly feathered birds as, for example, with the mallard duck. the drake, with gorgeously iridescent head and symmetrically marked body, could never be confused with his drab mate.

earth the ever-present water, containing the elements hydrogen and oxygen. Using the energy of sunlight, the green chlorophyll of plants then unites this carbon, hydrogen and oxygen into complex, energy-packed molecules of food substances, called "carbohydrates." These carbohydrates serve to nourish the plants themselves, and also act as food for animals that eat the plants. Then, in turn, the plant-eating animals furnish food for carnivorous animals. The carbohydrate food substances made by green plants may later, in the same plant or in other living things, be converted into different tissue substances, such as proteins or fats. However, in none of these subsequent transformations is there any gain in energy; indeed, in most cases there is a loss of energy. Hence the energy from the sun captured by green plants is used not only by the plants themselves, but also by a succession of animals. Therefore green chlorophyll is a vital link between the energy of the sun and living things, and were this green link to be broken, life would soon disappear from the earth.

Associated with chlorophyll in green leaves, and also found in roots and fruits, is a group of plant pigments called "the carotenoids." Carotenoids range in color from the red of tomatoes to pigments of a brownish hue, but let us consider here the prototype of the carotenoids, carotene itself. Carotene possesses a golden yellow color; it is, as its name indicates, the characteristic pigment of carrots, and also gives yellow corn and egg yolk their color. Carotene is of particular interest because it bridges the gulf between the animal and the vegetable kingdoms, and proves the inseverable interdependency of animals and plants, the two broad divisions of the living world.

The broken pattern of the zebra's markings serve as protection for these animals in the dim twilight, when they are most active.

Carotene is called the "precursor" or forerunner of vitamin A, because when plant foods like carrots or yellow corn are eaten by animals, the carotene of the plants is converted by the animals to vitamin A. Vitamin A is needed in ample amounts for good nutrition by the human being, and by all other mammals, so far as is known. This vitamin, as such, can be made only by the animal organism, yet animals are able to make vitamin A only if they are supplied with carotene as a raw material. The physiologist therefore considers vitamin A unique among the vitamins because, to borrow some biochemical terminology, it is the only vitamin of exclusively animal origin that is made from a precursor of exclusively vegetable origin. Thus animals depend upon plant pigments not only for their energy, as we have seen, but also for an indispensable vitamin, vitamin A. Some vitamin A for animals is derived, admittedly, from cod liver oil and similar fish liver oils, but the vitamin A in these oils came originally from carotene-bearing marine plants eaten by the fish.

Vitamin A in animals serves many indispensable functions, but one of these functions especially meriting mention here in relation to color is the use of vitamin A in animal vision. Without vision what would color mean to us subjectively? In the retina of the animal eye, localized in tiny organs called "rods," is a substance known as "visual purple." Visual purple is made by the animal body from carotene or vitamin A. When light entering the eye strikes visual purple in the rods, this pigment immediately changes color and becomes "visual yellow," and at the same instant transmits to the nervous system the sensation of light. The rods in the retina of the eye, with their visual purple, are particularly sensitive to dim light, so that when an animal lacks visual purple by reason of having a low intake in its food of carotene or vitamin A, vision in dim light is impaired, and a condition known as "night blindness" results. Hence for the ability to see in dim light, in addition to other equally important functions, animals are dependent upon the plant pigment carotene.

We have seen how carotene straddles the dividing line between the animal and vegetable kingdoms, thus highlighting the probable common origin of all things living today. But another pigment, hemoglobin, the red coloring matter of mammalian blood, illustrates still further this intimate relationship between animals and plants. Hemoglobin is the oxygen transporting principle of blood. In the lungs, hemoglobin is transformed to its oxygen-bearing form, oxyhemoglobin. Then oxyhemoglobin, after being carried to remote tissues of the body in the blood stream, releases to the tissues oxygen needed for respiration by every cell, and thereby reverts to hemoglobin. A color change accompanies this alteration in oxygen content, as is known to first-aiders who have learned to distinguish bright red, oxygen-rich arterial blood from bluish, oxygen-depleted venous blood. But hemoglobin interests us in this discussion mainly because chemists have shown it to be related to the chlorophyll of green plants! That a red animal pigment is chemically similar to a green plant pigment may appear surprising, but hemoglobin and chlorophyll not only contain the same chemical elements, (except that iron in the former replaces magnesium in the latter) but also have these elements connected in analagous molecular arrangements. The relationship of these two pigments has been epitomized by the eminent bio-chemist, Gortner, in this statement: "If one compares the formula of hemoglobin with that of chlorophyll, it will be noted that there is a striking similarity, indicating that the most important pigment of the plant kingdom and the most important pigment of the higher animals have much in common, and are actually modifications of the same structure."

Protective coloration as a concealment from natural enemies is a fundamental aspect of living color well known to any observant visitor to wilderness areas. Time and again the walker in upland forests is startled by the explosion of a covey of grouse from a spot that had appeared vacant as he approached it, so completely does the plumage of these birds merge into the forest background. The same phenomenon in reverse may be seen in the instance of the hawk moth, plainly visible as it flutters through the air, but then disappearing as it alights upon the rough bark of a tree. Protective coloration may even change with the season, as in the eastern varying hare, whose drab summer coat blends perfectly with the summer forest, but which develops an immaculate white pelage in winter, and thereby remains difficult to see against a background of winter snows.

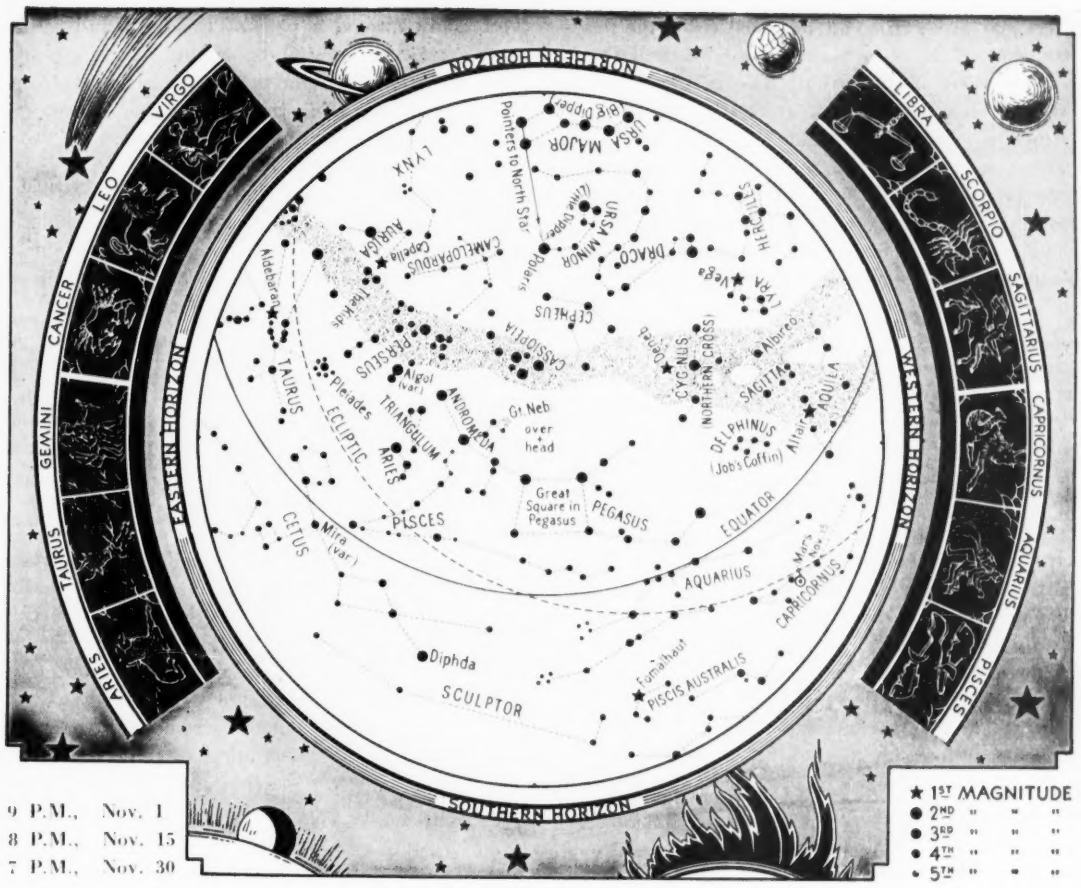
But other forms of protective coloration go far beyond simple possession of an exterior that blends with the background of the animal's customary environment. For the objective of protective coloration is attained by confusing as well as by concealing body outlines. Such confusion may be accomplished by means of patches or patterns of bright colors. Prime example of this so-called "dazzle" principle of protective coloration is the Malayan gecko. The brilliant stripe down the center of this reptile's back makes its identification difficult in its usual surroundings, and thus is most effective in concealing it.

PHOTOGRAPH BY L. M. CHACE

Color that protects is most common among the insects, such as the hawk moth, or sphinx moth

A third principle of protective coloration is one of most value in dim light, and hence of particular usefulness to crepuscular or twilight-active animals. This principle is the one of broken pattern; it is well illustrated by the coral snake and by the zebra, both concealed by their broken patterns in the dim twilight when they are both most active.

A final principle of protective coloration is the one originally pointed out by the artist, Abbott H. Thayer, and bearing his name. Since light in the forest comes from above, backs of animals are better illuminated than their under-sides, so that the lower surfaces are in shadow. This shadowed ventral surface would serve to call attention to the animal. But if the underside is lighter in color than the back, unevenness in lighting is offset, and the animal does not stand out against its background. The reader may demonstrate to himself the wide application of Thayer's principle of protective coloration by running over in his mind the many mammals, birds, reptiles, amphibians, and insects of his acquaintance whose lower surfaces are lighter in color than their (Continued on page 496)



To use this map hold it before you in a vertical position and turn it until the direction of the compass that you wish to face is at the bottom. Then, below the center of the map, which is the point overhead, will be seen the constellations visible in that part of the heavens. It will not be necessary to turn the map if the direction faced is south.

Sky Splendors in Taurus

By ISABEL M. LEWIS

THE zodiacal constellation of Taurus, The Bull, which extends from the northwest to the north of Orion is conspicuous in the evening sky from November far into April when it passes into the evening twilight. About nine o'clock in the evening early in November it is conspicuously in view in the northeastern sky in our mid-latitudes of the northern hemisphere. The two great clusters of stars in Taurus, The Pleiades and The Hyades, are among the most famous objects in the heavens and have been celebrated in story and legend among the tribes and nations of all lands from remotest antiquity.

The number of stars that one may see without telescopic aid depends upon one's clearness of vision as well as the transparency of the atmosphere. Usually one will see six or seven of the brightest of the Pleiades, which are arranged in the form of a small dipper. A few observers, under exceptionally clear skies or with remarkably keen eyesight, have seen as many as 11 or 14 without any optical aid. One should by all means observe the Pleiades cluster with binoculars, when more than a hundred stars of the group will be clearly visible. There are actually 225 stars known to be members of the Pleiades cluster. Alcyone, brightest of the Pleiades, is a star of third magnitude. The remainder of the stars visible in the little dipper which can be seen usually without any optical aid are of fourth, fifth, or sixth magnitude. As the Pleiades lie in a zodiacal constellation they are at times directly in the path of the moon and its brighter stars are frequently occulted, or temporarily hidden from view by the moon.

The V-shaped group of The Hyades contains the bright, red, first magnitude star, Aldebaran, the

brightest star in Taurus and supposed to be the fiery-red eye of the Bull. It is not a member of the Hyades cluster, however, and does not share in the common direction of motion of the 250 stars that belong to it and which is toward a point in the heavens east of Betelgeuze in Orion. The distance of the Hyades from the sun is about 130 light years and it is gradually increasing its distance from our solar system. It was only half this distance from the earth at its nearest approach, some 800,000 years ago, it has been estimated.

Both the Hyades and the Pleiades are known as moving clusters or open clusters, as distinguished from the globular clusters which are not members of our own galactic system but lie along its periphery and are spheroidal, compact groups, densely concentrated toward their centers. These are much greater in diameter and contain thousands of stars, in comparison with the several hundred, or even fewer, stars of the open clusters which lie within the galaxy. Some four hundred of these galactic clusters are now known. The Pleiades cluster, which is at a distance of more than 300 light years from our solar system, is a much more closely knit group than the widely scattered members of the Hyades cluster. It has a diameter of about 15 light years as compared to the diameter of about 800 light years for The Hyades.

Photographs of the Pleiades that have been taken with the aid of large telescopes over periods of many years have shown the existence of nebulosities surrounding the bright, hot, helium stars of the cluster. Long exposures with powerful telescopes show fainter extensions of such nebulosity all through the cluster. In many instances it has been clearly shown from observations made spectroscopically that the nebulosity near these stars has the same kind of light as the stars themselves and are dust clouds illuminated by the reflected light of the stars. Some of these stars are known, however, to expel from their surfaces—under certain circumstances, in which the effect of radiation pressure may exceed that of gravitational attraction—part of the star's mass. Even from the atmosphere of our comparatively cool and stable sun hydrogen atoms have at times been permanently expelled from such disturbed regions as sun spots and solar prominences with a velocity in excess of the velocity of escape from the sun. Some of these hydrogen atoms have been known to enter the atmosphere of the earth. The effect of radiation pressure from the sun on the tails of comets is well known. The lighter gases that originally formed a part of the head and nucleus of the comet are driven off under the action of light pressure from the sun in a direction always opposite to that of the sun; and after many returns to the vicinity of the sun much of the mass of the comet is dissipated in this way.

In recent years some remarkable observations have been made of the star Pleione and its nebulous surroundings in the Pleiades cluster. Pleione is one of the less bright of the stars that may be seen without optical aid in the small dipper-like configuration formed by its principal stars. It is difficult to detect visually because it lies so close to the brighter Atlas at the end of the handle. In color it is bluish. It is, therefore, one of the hot helium stars. It is clearly seen with the least optical assistance. When some observations of its spectrum were made by astronomers at Harvard and Yerkes some fifty years or so ago some most remarkable facts about this star were indicated. Pleione, it was concluded from the evidence, was spinning on its axis at a most terrific speed, about 100 times more rapidly than our own sun, which rotates at the rather leisurely rate of 2 kilometers, or about 1¼ miles a second at its equator. Its equator, moreover, lay in our line of sight. If the star, as a result of its great speed of rotation about its axis, should begin to expel some of its gaseous substance to form a ring or shell around its equator there should be some spectroscopic evidence of it. Eventually there was. In the year 1938 two astrophysicists found evidence almost simultaneously that Pleione had acquired a rather thin gaseous ring. Spectroscopic observations showed that the star was experiencing unstable conditions in its equatorial regions. These were causing it to emit from its surface streams of gaseous atoms to form an enveloping shell. This became increasingly dense and more noticeable for a few years as the outward acceleration of gases driven from the surface increased. Eventually, after a period of about 15 years, the source of the supply of expelled atoms began to fail. Normal conditions began to be restored to an abnormally active atmosphere and there was evidence that this temporary ring or shell surrounding the star was disintegrating and its substance dispersed among the vast dust clouds that exist so abundantly in this region. Not only in the Pleiades but in other parts of Taurus as well are to be found remarkable nebulosities and stars associated with them.

North of the Hyades is a strange variable nebula known after its discoverer as (Continued on page 496)

Security

By GILEAN DOUGLAS

I would like to go
Where the star runs with the river,
And all the things I know
Are season gift and giver.
I would like to stay
Where the trees are heaven-sharing,
And all the prayers I pray
Are calm and country-caring.
I would like to sieve
Soul and seed together,
So that each day I live
May be good growing weather.

The School Page

By E. LAURENCE PALMER

Professor Emeritus of Nature and Science Education, Cornell University, and Director of Nature Education, The American Nature Association

ORIENTATION IN SCHOOL

THERE have been, and will be, no end of outlines on orientation. This is natural because they have been, and will be, written by persons whose backgrounds and interests vary tremendously. In the special insert in this issue of *Nature Magazine* I have proposed another such outline that may be used as a basis for discussion. It is not final. It is obviously limited in some respects by the eight pages to which it had to be confined. It considers, also, the fact that *Nature Magazine* is written for use by a generally well-informed public but not for the most profound leaders in their field. We refer in the insert to Harlow Shapley's article in *American Scientist*, but not with the thought that we are offering another outline to put alongside his. His article was written for publication in a journal published primarily for use by members of Sigma Xi, the national honorary society of those interested in research in science.

An examination of many outlines of science for use in schools indicates that frequently there is little logic followed in their organization. While Dr. Shapley's *Cosmography* is designed to include "everything known or knowable in the universe," a school outline must be limited definitely to the ability of the users to know things; to its probable usefulness to them; to the ability of the teachers to use it, and to other considerations.

We do not, in the outline, give details of what should be taught at any school level. We do try to suggest some of the major areas that should be kept in mind by those planning a general outline or a general program. It is only natural that Dr. Shapley, a distinguished emeritus professor of astronomy, should emphasize in his outline details not significant to the average teacher. As one reviewer of his work writes: "The major difficulty will be that there will be few if any Shapleys available to teach this synthesis of all knowledge." The outline in this magazine is an attempt to increase the audience to which Dr. Shapley's effort was directed.

Teachers and others will have to—and should—modify our suggestions in terms of their own experience and interests. We hope that the outline may serve as a checklist that may lead to making more well-rounded programs than are offered in our schools.

We have deliberately begun the special insert with a verse, and ended it with another, because of our faith that sometimes verse tells a story more effectively than does prose. We do not imply by this that everything must be "jazzed up" for use by all. We just feel that Martin Sampson and his three infinities may have the effect on the readers of this article that the reading of the poem had on the writer of this article more than three decades ago. With equal satisfaction we close the insert with a verse by Eleanor Johnson Bogan, who added a human touch and the spirit of the true teacher in her verse "Adventure." In between these two we felt we must call your attention to Patrick Geddes' attempt to organize his thoughts through a museum plan on a never-to-be-forgotten day when he, and I, and another wandered through libraries, woodlands and gorges exchanging ideas at a rapid rate and enjoying every minute of it.

One of my chief regrets in connection with the present outline is my inability to illustrate it with pictures of Geddes on that day. This would include a snapshot of him sprawled on his stomach in front of my bookcase with his long, flowing beard back over his shoulders, the glee with which he drew the hanging tower of his museum and named it politics, and the genuine satisfaction he got taking a swim in his native bathing suit below Taughannock Falls on a hot day, with the white of his beard streaming back, like the foam from the bow of a ship, as he used his strong breast stroke and approached the spray of the falls. These pictures must remain in memory only, but they do enliven the prosaic representation of his attempt to present his outline of the "known and knowable" in the universe.

It would seem that the average pre-college teacher will find much more importance in the materials suggested in the outline between the two extremes of the infinitely great and the infinitely minute. They should not get the idea, however, that it is adequate to parrot the items suggested under the first column dealing with the structural aspects of matter. These things must be considered as they apply to energy, to time, to space, and to the intelligence, and as these are appropriate to the situation in which the outline is to be used.

Without apology, we attempt in this outline to introduce much that is represented as being in the field of social science. We do this because we feel that social science and other sciences should not be kept too widely separated, at least in the school program. We feel that each may make a major contribution to the other, that this is not usually appreciated and that if they are not brought together at the pre-college level they are not likely to be brought together in later years. This continued separation is possibly one of the things that has led to misunderstandings of tragic importance in the world of human affairs, and may have accounted for the lack of adequate leadership in world politics and world economics.

We offer no apology for suggesting that the teacher of biology has some responsibility for developing in pupils the habit of acting in accordance with the dictates of conscience. We feel that too often our school programs have been too academic or too practical, and too infrequently give recognition to what is basically right. Our definition of conservation as wise use implies that it is a training designed to put things to use, presumably for man. We like better, as suggested elsewhere, the idea that conservation is science with a conscience, which definition implies something more dynamic than Aldo Leopold's excellent definition to the effect that conservation is man living in harmony with the land. Somehow his definition suggests a lethargy, which its originator rarely showed and which is lacking in the newer definition that has been proposed.

Possibly we can illustrate our point by mentioning a recent discussion with a group developing an outline in the middle West. All were agreed it was desirable that the significant parts of the real environment be presented to the students. Then someone proposed that there be included the idea that we have some responsibility in passing along to succeeding generations as much as possible of the wealth that we have inherited from the past. This was defended by a quotation from the conservation report of the American Association of School Administrators. Somehow it seemed that that is not what one's conscience might suggest. Instead of passing on as large a "share" of what we inherit it would seem that the greatest satisfaction should come from passing on more than we inherit. There is more fun in growing than in staying still, more fun in working than in idling, more fun in adding than in subtracting or just refraining from subtracting.

It is hoped that the proposed outline will stimulate a host of modifications. If it is accepted as it is it will have failed of its purpose. It is quite probable that the greater number of suggestions will come for expanding details that are implied but not listed in the outline.

This outline is given as being something different from the usual insert. In the next insert we will return to the standard pattern, which teachers may find more useful because of the specific content presented. In the past we have periodically given general numbers such as those dealing with water level, tracking, formulae, outdoor living and so on. We hope that the present departure was not too great, and that we will still have you with us when we return to our regular schedule.

Dodged-out portraits center interest on the dog's face and fade out the body and background. With models like this Brussels Griffon it is difficult even to see the eyes, and harder still to focus on them. Thus the sharpest focus here is on the nose.

This is a nice "smile." The model is a Pomeranian.

Camera Trails

By EDNA HOFFMAN EVANS

IT IS "Not what we give, but what we share," according to James Russell Lowell in his poem, "The Vision of Sir Launfal," that makes the gift worth while. Without this sharing, the poet continues, "The gift without the giver is bare." I think of that quotation sometimes when I am faced with the problem of selecting gifts for my friends. It is particularly appropriate now that Christmas is just around the corner.

Whether we realize it or not, we photographers do have a great deal that we can share with others. It may never have occurred to us before, but our cameras are devices of great wonder and mystery to people who do not understand photography. With those magic black boxes we can capture and preserve possessions that are often precious beyond words to the other fellow. We, who use our cameras to photograph whatever tempts our fancy, often fail to realize what kindnesses we could do with little effort. It is amazing sometimes how greatly appreciated are the simple acts that we scarcely consider worth mentioning.

Extremely pug-nosed dogs like this Pug do not look their best in profile.

What do I mean? Just this—have you a friend who cherishes something? Does he have a good picture of that prized possession? Has he ever thought of it as photographable? More important yet, could he find a commercial photographer who would take the time and the pains necessary to photograph it, and then print up the picture in an artistic manner?

There are many dog-lovers among my friends, but none of them are photographers. The snapshots they take of their canine pals are rather sad ones, photographically speaking, because they are for the most part vague and out-of-focus blurs that have only a faint resemblance to the original dog. For a long time, though, it did not occur to me that my friends might want good portraits of their pooches. When it did, I was so surprised and pleased that I still feel the discovery was a major achievement.

It was just about this time last year, when the Christmas gift list was one big question mark, that I had what I now think was a flash of pure inspiration. Going to the phone I dialed the number of the friend whose gift was puzzling me most.

"Can you bring Sugar over in about a half hour?" I inquired. "I will have the lights set up and I want to take her picture."

"We will be there," my friend answered promptly.

Well, Sugar was not the most cooperative dog I ever photographed. Still pretty much of a puppy, she refused to stay in one place very long, but with patience and persistence I managed to get several shots of her. My friend was so thrilled with the picture possibility that she stayed until I developed the negatives and was able to announce, "They are okay." The final prints pleased her mightly.

My set-up for dog pictures varies, depending on circumstances. Usually it is best to photograph the dog in its own home, for in familiar surroundings it is less apt to be nervous. A blank wall serves well for a background, and the dog should be seated on something—a box, stool, backless couch—small enough to restrain it somewhat and substantial enough to hold steady. Insecurity of perch will naturally make a dog restless and uncooperative.

I use two, or sometimes three photofloods in reflectors. My arrangement of lights is a modification for this sort of work.

of the traditional triangular light pattern, and it, too, varies depending on the size and color of the dog. I like one light set a little higher than the top of the dog's head, diagonally from the front, and another lower, perhaps chest high, a little farther back on the other side. The third light, when used, is low, shooting up from behind to give backlighting. This third light is particularly useful in giving highlight behind the ears. I always use the light meter but, as a rule, I can shoot at about 1/100th at f:9. This speed will stop most sudden small movements, although it will not stop a dog that is determined to jump down from its perch.

Focus, as in all animal pictures, should be on the eyes. Depth of field is a problem with long-nosed dogs, but it is not an insurmountable obstacle. Heat under the lights, of course, makes the dogs pant, but I do not find a nice "smile" objectionable. Just before releasing the shutter I make some sort of funny noise to catch and freeze my model's attention for the critical moment. The camera is at the dog's eye level.

It is amazing how differently long coats and short coats will photograph, and the lights should be arranged to bring out the best luster. Color, too, is a problem—all-white or all-black dogs are extremely hard to photograph. But here, too, the light can be adjusted to get the best effects. Be careful, in all cases, that the highest light does not shine directly on the top of the dog's head, for that destroys detail and makes it difficult to separate the head from a light background. Depend on backlighting, rather than top lighting here.

Darkroom work is also important, for the photographer can do much with his final print. I like the dodged-out portraits that center interest on the dog's face and then fade out the body and background. Printed on matte paper, toned or untoned, you have a picture that anyone would be happy to own.

Not all my attempts have been successful, needless to say, and I have learned a number of things by making mistakes. With dachshunds, for example, it is amazing how long those fellows are. Clear focus from nose-tip to toenails, while not so far up and down, demands much greater depth than does the same view of a long-nosed collie. As for the problem of full view versus profile, cockers and others of that nose type look good in profile, very sharp nosed-dogs like collies are better three-quarters view, while extremely pug-nosed dogs not do look their best in profile.

Nor does one need to confine his good works to dog portraits. Parents, of course, deeply appreciate pictures of their children. But most parents do, at one time or another, take their offspring to a commercial photographer. Even so, they are sure to appreciate the little informal pictures than an amateur photographer can take and work up in his darkroom.

But why stop with dogs and children? There are other kinds of pets that are cherished. Cats are also favorite but rarely photographed pets, not to mention other kinds of animals from hamsters and white rats to horses. Flowers, too, and pictures of a person's house can give pleasure. So can pictures of favorite scenes. Have you a friend, for example, who loves his garden, or cherishes some plant, or delights in the view from a particular window? If so, do those beloved things have photographic possibilities? There is the Christmas present you can give; one which will be appreciated much more than anything you can buy from a store.

In case I may sound too starry-eyed—and I am enthusiastic about photographs for Christmas let me inject several words of warning. Unless you are very brave, or skilled at taking portraits of people, beware of tackling an adult portrait. A candid, unretouched portrait, harshly lighted, is not as kind as the mirror, and we adults sometimes resent the traces of time that the camera finds in our faces.

As for a second sour note a few people may want more pictures than you feel inclined to give them. They do not realize that film, paper, and chemicals cost money, while darkroom work is tiring and time-consuming. The thing is to know your friends, and to share your photographs accordingly.

HIGH SPEED FLASH. While we are on the subject of gift giving, we might as well talk about gift-receiving, too. Any photographer, I think, would be pleased to find under the tree on Christmas morning a copy of the newly re-issued book *Flash*, which deals with the techniques of high speed photography.

Flash is written by Harold E. Edgerton and James R. Killian, Jr., and the recently revised edition is published by the Charles T. Branford Company, 551 Boylston Street, Boston 16, Mass. Its price is $6.50.

When the book was first published, back in 1939, high-speed photography was so new that it was far beyond the reach of the ordinary photographer. It was, in fact, virtually confined to Professor Edgerton's laboratory at the Massachusetts Institute of Technology. In the years that have passed since that time the electronic system, sometimes called stroboscopic, speedlight, or strobe, has become widely available. News photographers carry portable electronic equipment to sporting events, naturalists go into the wilds with it, commercial studios use it for portraits and for color photography. It has, indeed, opened new realms of picture possibilities.

For the mere sake of keeping up with the times, if for no other, I think *Flash* is a book that amateur as well as professional photographers should know.

(Continued from page 498)

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SKY SPLENDORS IN TAURUS

(Continued from page 492)

Hind's Nebula. It is southwest of a faint, variable star called T Tauri. Hind's Nebula was discovered 100 years ago and it has experienced many changes since then. Discovered with a 7-inch telescope it has at times disappeared in the largest telescopes. Now it is easily observable in moderate-sized telescopes and it has become visible along a long arc concave toward T Tauri. Beyond doubt a connection exists between star and nebula. Still more remarkable is the fact that T Tauri is also embedded in a small, bright, elliptical nebula which is, itself, variable in brightness. Another strange fact is that this nebula has a bright-line spectrum such as almost always is associated with and excited by very hot, blue stars. Yet T Tauri, clearly associated with this nebula, is a cool, yellow dwarf star. This region of T Tauri is about 500 light years from the sun. The bright nebula in which the star is embedded probably does not extend as far as a light year from it. There is no direct correlation between the light changes of T Tauri and those of either nebula. All occur irregularly. It has been suggested that there may be a play of light and shade as large obstructions or dust clouds near the star may at times obstruct the illumination of other near-by regions. The causes are still in doubt.

A most remarkable object in Taurus is the Crab Nebula about a degree above the more southerly of the horns of Taurus. It has, apparently, no central star. If so it would have to be much fainter than the nebula, which is remarkably brilliant. It consists of two parts: a large shell and a fine network of filaments which show strong bright lines in the spectrum. This nebula is noted also for the fact that it is a strong source of radio waves. If there is a central star the light of the nebula must be 1000 times more brilliant than that of the star. There is reason to believe that the Crab nebula is what remains of a supernova which appeared in the year 1054, and was recorded in the Chinese and Japenese annals, and was evidently as brilliant as Jupiter or Venus. The nebula which resulted is even now increasing in diameter. The estimate of its distance is between 3,000 and 5,000 light years.

Mercury will be a morning star in Libra this month and at greatest western elongation on Nov. 14; and this is the best time of year to observe it before sunrise. It will be seen at that time about 15 degrees above the southeastern horizon. Venus will be at inferior conjunction with the sun on Nov. 15 and too near the sun for observation most of this month. Mars is now about as bright as Vega or Capella. It will be found in Capricornus and is low in the southwest all the evening, setting after midnight. Jupiter is now in Gemini. It rises several hours before midnight and is visible from then on to sunrise. Saturn comes into conjunction with the sun on Nov. 4th and will be too near the sun to be seen until late in the month.

The Leonid swarm of meteors which comes from the direction of The Sickle in Leo will be seen in greatest numbers after midnight on Nov. 16. This is not, ordinarily, a swarm of great strength and bright moon light will also interfere with observations of the meteors this year.

LIVING COLOR

(Continued from page 490)

backs.

The last practical aspect of living color we should consider is color as a secondary sexual characteristic, and its importance in mating. A well-known humorous magazine once published a cartoon showing two turtles meeting, and one saying to the other, "I'm a girl." This hypothetical dilemma of inability to distinguish sex could never be suffered by the brightly feathered birds. Consider for example the mallard duck; the drake o this species, with his gorgeously iridescent head, immaculate necklace, and symmetrically marked body could never be confused with his drab mate. It is true that not all animals possess the visual ability to distinguish color, but among those that have such ability are the brilliantly colored birds whose handsome plumage plays an important role in their courtship displays. And color as a mating display in birds is not limited to the plumage, for the male man-of-war bird inflates dazzlingly red throat pouches during his courtship ritual, and the male prairie chicken displays similar air sacs, bright orange in color.

Thus living color in the form of various pigments traps into foodstuffs the solar energy needed for existence by plants and animals alike, supplies a vital vitamin, carries oxygen in the blood stream of mammals, and provides for species-survival through protective coloration and mating displays. And without living color, this world would be a much less lovely place to live in.

Watershed Congress

The American Nature Association is one of the conservation organizations joining in the sponsorship of a National Watershed Congress to be held December 6 and 7, 1954, in Washington, D. C. Ten study committees have been at work doing advance work on various aspects of major importance to watershed planning. They will draft statements that will serve as guides for the participants in the Congress. Sessions will be held at the Statler Hotel and the public is invited to attend.

Films

"The World Around Us" is the title given to a series of ten 16mm films in color devoted to the living world of Nature. They have been produced by John H. Storer, who has devoted his life to the story of the conservation of our life-supporting resources. Full details about these films may be obtained from Department NM, Pictura Films Corporation, 487 Park Avenue, New York, 22, New York.

Collector

Residing at 52 George Street, Norwood, Adelaide, Austraiia, Professor B. Kaspiew, a refugee, asks us to give publicity to the fact that he is available to supply botanical and zoological specimens to museums, universities and individual collectors. He writes that he has now available some 1500 plants, seaweeds, insects, crustacea, etc.

Cottam to Utah

For a quarter-century a member of the staff of the U. S. Fish and Wildlife Service and its predecessor Bureau of Biological Survey, Dr. Clarence Cottam has resigned from his post as assistant to the Director and took over the post of Dean of the College of Biology and Agriculture at Brigham Young University, Provo, Utah, at the beginning of the fall term. Joining the Service in 1929 as a biologist in the Section of Food Habits Research, Dr. Cottam rose to assistant director. He is an authority on the economic status of birds, and on waterfowl, wildlife and refuge management.

John Wesley Powell

Beyond the Hundredth Meridian. By Wallace Stegner. Boston. 1954. Houghton Mifflin Company. 438 pages. Illustrated. Foreword by Bernard DeVoto. $6.00.

There is a subtitle to this splendid book—"John Wesley Powell and the Second Opening of the West"—and in an introductory note the author says that this book is "an attempt to write a biography that is the history not of a personality but of a career." He is interested in Major Powell: "As the personification of an ideal of public service that seems peculiarly a product of the American experience." John Wesley Powell was, indeed, a controversial character, who dramatically achieved the first passage of the Green and Colorado Rivers through all their canyons. Less dramatic, perhaps, was his constant striving for governmental activity that would study our nation scientifically. Wallace Stegner has written a penetrating and understanding story of the man and his career, and has made an outstanding contribution to the story of the West.

★ ★ ★ ★ Shopping Outdoors ★ ★ ★ ★

There are more uses for **Brow-Lite** than, we suspect, the manufacturers realize—that is, more uses for outdoor people. This gadget fits on one's forehead and over the ears like glasses, has a little light adjustable to angles, and is powered by two standard flashlight batteries. It would be useful to spelunkers who poke around in caves, to naturalists on the prowl at night, or those indulging in night sports, and has a multitude of other practical uses where a good light is needed and when it helps to have both hands free. It is available from the Ozilam Co., 1513 Arapahoe St., Denver 2, Colorado, for $4.98.

"Buppo The Pup" decorates a new line of children's pillow cases. These colorful cases show "Buppo" when he is ready to get up and when he is greeting the sandman. The pillow covers are available for pillows 13 by 18 inches, and 21 by 28 inches, and are washable and with fast colors. At $2.98 a pair for the smaller size and $3.49 for the larger, they are available from Dept. NM, H. M. Smith Manufacturing Co., 654 Fairmount Ave., St. Paul 5, Minnesota.

Swish-O-Dish adds a new touch to dish-washing by attaching a hollow plastic handle to a sturdy sponge. Into the handle goes liquid soap or detergent, so the suds get into hard-to-reach places. It sells for sixty-nine cents from Cossman Company, Department N.M., 6612 Sunset Blvd., Hollywood 28, California. Proved quite a hit at home.

DuVerre, Inc., Marine Division, P.O. Box 97, Hamburg, N. Y., announces a boat and canoe patching repair kit that can be used with all types of material. It contains **DuVerre's Polyester Resin-Chrome Treated Fiber Glass** and really puts a new skin on any type of boat where repairs are needed. Two sizes of kit at $2.50 and $4.50. Full details on request, including information on complete boat coverings.

The manufacturers call it the greatest boon to the home gardener since the power mower, and it looks as though they are right. It is **Hydromix,** a gadget that attaches to water spigot and hose, and automatically mixes water soluble or concentrated liquid plant foods, maintaining proper proportions. It works with any type nozzle or sprinkler. Sold by Doggett-Pfeil Company, Springfield 1, N. J., at $4.95, or at stores featuring garden supplies.

American Homecraft Co., 3714 Milwaukee Ave., Chicago 41, Illinois, announces a power kit that features an automatic, portable **Fish-Scaler** that lifts and removes fish scales without cutting them or tearing the flesh of the fish. A plastic guard confines the scales. In the kit are a small rise for tying flies, a carborundum stone for sharpening hooks, knives and such, a felt buffing wheel for polishing tackle, and a small fibre brush for cleaning reels. Costs $19.95, postpaid.

Also for fishermen is the **Fisherman's DeLiar,** a pocket-size gadget that accurately weighs fishes up to 28 pounds or 42 inches in length. Sold by Empire Enterprises, 1513 Charlotte St., New York 60, N. Y., for $2.98. Nice gift for a fisherman friend.

Fleas-Off is said to be the only insect repellent made specifically for dogs and has been subjected to five years of testing before release by Whitmire Research Laboratories, 339 South Vandeventer Ave., St. Louis 10, Mo. Applied by aerosol spray, it is non-poisonous to the dog and may be used freely and safely to kill insects around the dog's quarters. Found generally in drug, sporting goods and pet stores, but if not available the makers will direct you to a source of supply. Five-ounce can costs $1.25.

Interior decorators seem to like a quaint **Hurricane Candle Lamp** that features an old fashioned design, with the modern touch of a spiral grille-work base, fashioned from black iron. Complete with candle from Giftcrafters, Dept. N.M. P.O. Box 677, Richmond, Va., for $1.50.

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CAMERA TRAILS

(Continued from page 495)

Even though the amateur may never expect to take pictures at speeds of 1/500,000th second, he should know what is possible at such speeds. The photographic illustrations in the book are fascinating. The flight pictures of birds and bats were particularly interesting to me, even though it is hard to realize that a speed of 1/100,000th second is necessary to "stop" the motion of a hummingbird's wings. As for the photograph of a chickadee coming in for a landing, any photographer of birds will find it highly appealing.

Added to the book in its revised edition is a section of supplementary data explaining, for the benefit of the reader who knows little about electricity or associated equipment, the theory of electronic flash lighting and electronic flash producing equipment. There is also a good bibliography.

The book describes the new vistas opened by high-speed photography in this manner:

"Beyond the horizon of human vision lies a whole world of unseen rapid motion. It surrounds us in our everyday life, and we are unable to penetrate it just as, before the telescope and the microscope, we were unable to break through the barriers of space and see the mountains and craters of the moon, or the germs that make us ill and the micro-organisms that make our wine.

"To enter this absorbing world of motion, the eye must have an accessory that will manipulate time as the microscope manipulates space—that will, moreover, harness time to space visibility. . .

"High speed properly describes single-exposure cameras that take photographs with exposures shorter than 1/100,000th of a second, and motion picture cameras that operate at speeds in excess of 300 pictures (frames) per second (the motion picture camera normally operates at 16 to 24 frames per second)." Most of the pictures in the book were made with exposures shorter than 1/50,000th of a second, and the motion pictures were taken at rates as high as 6000 per second.

All in all, *Flash* is a fascinating, informative, challenging book. It is one any photographer would be happy to own.

"MR. TOAD"

BY LOUISE SCOTT

ALTHOUGH *Britannica* unfeelingly refers to our garden friend as a "tailless batrachian of stout build, with more or less warty skin," we regard him with affection. To be sure, he is the color of the earth itself, with small evident care for his appearance. But each summer as we weed he is discovered as the resident curator of our flowers. During a shower he rests beneath a rose geranium.

In reminiscent devotion to Kenneth Grahame, we call him "Mr. Toad," and one day, in our presence, he briefly assumed the role. There was no wind in our willow tree that warm afternoon. From a discreet distance Mother and I and one butterfly witnessed our toad's performance.

On one of his little winding paths among our flowers, he shuffled himself a comfortable hollow and settled in the sun, apparently asleep. Soon, as if by magic, his skin coat split slowly down the middle of the back. It peeled away tightly toward each side and down, revealing bright new apparel underneath, cream-colored and handsomely spotted with brown.

"Mr. Toad" remained quiet a moment. Then, quivering eagerly and with odd contortions, he worked to extricate each hind leg. After a pause, he reached one forearm up over his shoulder and then the other, his tiny hands tugging as a boy's when pulling off a "turtleneck" sweater. At length he was successful in ha[illegible] his old skin, in one piece and inside [illegible], off over his head.

Out popped the glistening eyes of our terrestrial friend. His whole body matched in moist brilliance, gleaming as if in white satin lightly flecked with brown. Bright beyond belief, "Mr. Toad" then rested, resplendent and vibrating from unwonted exertion. At this juncture, he presented a sparkling contrast to his dusty habitat.

But his manners! With both hands he soon rolled his discarded garb into a small tight ball, pushed it into his mouth and with effort gulped it down. For a long period thereafter, with occasional shivers of excitement, our toad relaxed in his sunny hollow, seeming proudly to enjoy his transformation. He seemed content with our Concord, Massachusetts, garden and its particular flowers, and with the grubs and flying things that visited them. This was his chosen habitat.

Finally, as if with a sense of responsibility, he hopped heavily off toward our bush heliotrope. Dustier and dustier he became and presently as sombre as before. All sheen had gone. Our toad's little drama was quite over, but we had seen his vivid performance with our own eyes.

Briefly Noted

Walk Quietly. By Frances S. Parker. Francestown, N. H. 1954. Marshall Jones Company. 112 pages. Illustrations by Robert Douglas Hunter. $3.00. An especially attractive book of delightful Nature poems by a teacher-poet whose understanding of and appreciation for Nature makes this a collection to be treasured. It would be a charming gift to any lover of Nature and poetry.

Africa Drums. By Richard St. Barbe Baker. New York. 1954. The British Book Centre. 159 pages. Illustrated. $3.00. A book by the noted British forester who probably has come closer than any other man to the African native. A fascinating book.

Tobacco Dictionary, Edited by Raymond Jahn. New York. 1954. Philosophical Library. 199 pages. Illustrated. $5.00. The story of tobacco, its history, manufacture and use told in dictionary form. Tobacco has a language all its own.

From Pipes Long Cold. Alice Hirsh. Boston. 1954. Bruce Humphries. 64 pages. $2.00. A collection of lyrics, ballads and narrative poems dealing with the early Indians and the days when they roamed this continent in freedom.

The Painted Men. By T. C. Lethbridge. New York. 1954. Philosophical Library. 208 pages. Illustrated and with end maps. $6.00. This is the story of the Picts as they were called by Ceasar's soldiers from Rome. It is a fascinating picture of the people of the British Isles 1500 years before the William the Conqueror.

The Energetics of Development: A Study of Metabolism in the Frog Egg. By Lester G. Barth and Lucena J. Barth. New York. 1954. Columbia University Press. 117 pages. $3.00. A study sponsored by the American Cancer Society, presenting hitherto unpublished researches.

My Garden of Time. By Ruth Marian Wilson. Boston. 1954. Bruce Humphries, Inc. 64 pages. $2.50. A collection of poems by a sensitive lover of the outdoors and an able poet.

Air Pollution and Community Health. By Clarence A. Mills. Boston. 1954. Christopher Publishing House. 180 pages. $2.75. An important discussion of a problem of growing importance to human health.

Discover the Stars. By Gaylord Johnson, revised with additions by Irving Adler. New York. 1954. Sentinel Books Publishers, Inc. 130 pages. Illustrated. 75 cents. A beginner's guide to astronomy presented in popular form.

Hunting Ducks and Geese. By Edward C. Janes. Harrisburg, Pa. 1954. The Stackpole Co. 187 pages. Illustrated. $5.95. Practical advice to those who find fun in the duck blind.

Lassen Bulletins

An excellent group of booklets are available from the Loomis Museum Association which is a non-profit distribution organization sponsored by the Naturalist Department of Lassen Volcanic National Park. These are "Geology of Lassen's Landscape," by Paul E. Schulz, 55 cents; "Pictorial History of the Lassen Volcano," by B. F. Loomis, 85 cents; "Guide to Lassen Peak Highway," by Paul E. Schulz, 25 cents; "Stories of Lassen's Place Names," by Paul E. Schulz, 40 cents; "Birds of Lassen Volcanic National Park and Vicinity," by Cyril A. and Robert C. Stebbins, 85 cents; "Fish and Fishing in Lassen Volcanic National Park," by Merlin K. Potts, 40 cents. In ordering any of these booklets 12 percent should be added for postage, and, if a resident of California, 3 percent for sales tax.

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ENGLISH HOLLY for Christmas decorating. Heavily berried strain direct from grower to you. 1 pound $2.00 postpaid. 3 pounds $5.00. Mistletoe $2.00 for a generous supply. Nichols Garden Nursery, 1190-A Pacific North Highway, Albany, Oregon.

THE UNEASY SLEEP OF WINTER BUTTERFLIES

(Continued from page 468)

Unfortunately this was the fate of all my three mourning cloaks. They lived on through December, and into January, both No. 1 and No. 2 showing much activity, while No. 3 remained quiescent for a period of thirty days. On December 21 both of these lively *antiopas* became so restless that No. 1 was released to fly about the room.

A few days later, when the noonday temperature rose to 70°, both of the more wakeful butterflies set forth from their shelters and ascended to the skylight's peak, where they freely circled on buoyant wings. They enjoyed what proved to be one last exuberant fling before they settled to rest on the skylight's lower sash. Then, after a cold spell, all three boxes were opened on January 5, only to reveal both No. 1 and No. 2 in an apparently dying condition, although the latter *did* weakly expand its feeble wings. As usual, the posture of No. 3 remained unchanged.

Had any other convenient room offered darkness and a low constant temperature, and therefore a more appropriate sanctuary, the outcome might have been more fortunate. For it is well known that the alternate freezing and thawing temperatures that occur in the fluctuating weather of an inconstant winter are less favorable for hibernating butterflies than the steady cold of a moderately severe season. Both indoors and out, in short, frequent and marked variations in temperature impose too excessive a strain on the sensitive organizations of the hibernators. Even so, my mourning cloaks showed much hardihood. Indeed, the last activity displayed by them occurred hardly more than six weeks short of the date when this species sallies forth from outdoor retreats to engage in what may prove to be its true, sensonal awakening of spring.

So unique and informative, then, was this whole demonstration that it won a deserved tribute from another appreciative witness. For, on one of those exceptionally mild afternoons when the *antiopas* freely rose to circle and make holiday, a model posed for me and, on her return to the city, regaled her friends, so I was afterward told, with the highly improbable tale of a suburban studio alive with butterflies in midwinter.

THE ISSUE AT THREE SISTERS

(Continued from page 465)

the Horsepasture Mountain ridge to the summit of Horsepasture Mountain, followed the ridge southward to the summit of Olallie Mountain, then down Eugene Creek and Horse Creek.

To quote from the account of the trip that was written by Virlis L. Fischer, Chairman of the Conservation Committee of the Mazamas, for the Western Outdoor Quarterly:

"The hike down Eugene and Horse Creek provided one of those unforgettable rugged canyon adventures. There were some 22 wet and dry crossings without benefit of bridges and the waters varied from swift and fairly deep to rushing and deeper.

"The trail up to Horsepasture Mountain was one of the most beautiful many of the group have ever had the privilege to travel. The area is a veritable garden of wildflowers in riotous profusion, color and variety."

After discussing the tree associations, Mr. Fischer concludes:

"Its [the ridge region] loss, for esthetic enjoyment and scientific study purposes, would be an irreparable tragedy. We would not want it on our conscience." And he hopes the United States Forest Service will "weigh the problem in the light of the possible future esthetic and recreational needs of the American people."

Olaus J. Murie, President of the Wilderness Society, says: "A valley is a unit, and a stream is the very life of a valley, the feature that dominates its character."

The area needed to preserve this valley as a whole, and to protect the unique ridge region, is only 12,400 acres of the 55,620 acres that the Forest Service proposes to remove. This allows 43,220 acres to be reclassified and added to their sustained yield unit. A study is under way to find out how much of the commercial timber is on the western slope of Horse Creek-Eugene Creek. The present estimate is much less than the needs for the Eugene area for one year. Perhaps those needs could be met by reduction of waste and by further finishing of the lumber product. Then this superb example of wilderness could remain for future generations. This type specimen of the western or older Cascades, with continuity across the canyons to the high Cascades, cannot be replaced, once it is destroyed!

"SEA WOLVES" OF THE WEST INDIES

(Continued from page 472)

year, another seal was seen to crawl out on a jetty of the pass. It was described to be about five feet long, appeared to be about 150 pounds, and was a light chestnut brown in color. The observer and crew members called it a "land porpoise." When the observer was asked why he did not think it was a seal, he replied that he ". . .thought seals lived around the north pole." However, Captain Curtis Everson, who was in charge of the boat and who had traveled widely over the seas of the world, told them the animal was a seal. He demonstrated an unusual interest in the animal, looking for it on every trip. Members of the crew teased the Captain, saying, "That's no seal, Cap.; that's a mermaid." In addition to the above records, a seal was seen at Port Isabel, the southernmost town of the Texas coast, during the early 1940s.

Professional zoologists in recent years have initiated inventories of the rare and vanishing species so that they might have some basis on which they could institute management measures that would conserve or augment the numbers of an endangered species. In March, 1950, Dr. Raymond M. Gilmore, of the U. S. Fish and Wildlife Service, attempted to make and air census of the monk seal in the West Indies. He flew the cayos of the Gulf of Campeche with John K. Howard, representative of the Harvard Museum of Comparative Zoology, but he saw no seals. He stated, however, the scattered reports from lighthouse keepers and others, indicate that a few exist in the Caribbean area. At present, he is preparing a more extensive report on the present status of this seal.

Sadly, mammalogists anticipate that there is every chance that the West Indian monk seal will go the way of the great auk of the far north, the little Carolina parakeet, the magnificent Steller's sea cow, the quagga, and the others, whose passing have been so well-documented. Obviously, the low density level of the monk seal population is a result of manhandling, and, in a sense, the remnants are struggling to recover, but without success. Why? One of the mysteries of animal populations is why recovery is so difficult after a population has been decimated below a certain point. The range of the monk seal is relatively large, the numbers are few, and environmental conditions or rookeries have been usurped by man, so that these factors combine to preclude successful and frequent breeding for them. The monk seal owes its demise to man; the least that man can do is be sympathetic and try to bring about changes for the better.

Indian Birds

The Birds of Travancore and Cochin. By Salim Ali. New York. 1951. Oxford University Press. 436 pages. Illustrated in color and line drawing by D. V. Cowen. $6.55.

Travancore and Cochin lie on the southwestern tip of India and the faunal and floral relationships of the region are closely similar to those of southwestern Ceylon and the western Ghats. Its avifauna is rich and varied and, with many species, separated by considerable distance from congeners. The book is an ornithology of the birds found in this area and describes their field characters, status and habitat, distribution outside the region involved, habits and other details. The author adds this book to two other bird books that he has written, one of these *The Book of Birds of India.*

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UNDER THE MICROSCOPE

By JULIAN D. CORRINGTON

ONE-EYED SHRIMP

THE little lady whose portrait embellishes these drab columns is only one-tenth of an inch long, but it would be a serious error to judge her as thereby of no significance to mankind. But pardon,—let us first introduce her. This is Mrs. Cyclops, Gentle Reader, a matriarch of that populous throng, the microcrustacea. The last time we had occasion to discuss any of her kinfolk was back in the October issue of 1938, in a little article entitled "Daphnia and Company," and it is more than high time we paid some further attention to these interesting and important animals.

The term "microcrustacea" is one of convenience rather than classification, though it more or less agrees with Entomostraca, the subclass that includes the smaller members of the Class Crustacea, some of them popularly known as water fleas and fairy shrimps. Our heroine for this month belongs to the Order Copepoda (which indicates oar-feet) a large group of minute creatures, distributed all over the world, along with the Cladocera, to which Daphnia belongs, in both fresh and salt water. Hegner made Copepoda a subclass, and the Order then becomes the Eucopepoda. The Cladocera are often comical in appearance; Daphnia may be a clown but is never a sylph. Copepods, on the other hand, are symmetrically graceful and streamlined. Some are transparent, others are remarkable for their coloration.

These sprites may be very tiny, but they have a complex structure all the same, and it takes a trained person working with a high-powered binocular microscope and very fine instruments to dissect so small a subject and determine the structures essential for accurate classification. They have a head, thorax, and abdomen, or the first two of these body divisions may be united to form a cephalothorax, as in cyclops. There will be only one joint, however, capable of any extensive flexure, and that is usually the one between thorax and abdomen, though in cyclops it lies between the fourth and fifth (out of six) thoracic segments. Some specialists speak of that part of the body between head and movable joint as the *metasome*, and that behind this joint as the *urosome*. Cyclops has a cephalothorax of 8 somites, and metasome of 3, and a urosome of 5 plus the telson, which bears two furcal rami, with long plumose bristles. There are two pairs of antennae, the first often distinguished as antennules, and the mandibles have a toothed gnathobase projecting toward the mouth, and a papilla bearing a tuft of bristles.

1. Female Cyclops carrying egg-sacs, 70X. Slide courtesy Ward's National Science Establishment.

There is a single ganglionic mass in the ventral cords of the nervous system and no organs specialized for circulation or respiration. Some of the microcrustacea have a heart that can be seen beating through the transparent body wall, but not cyclops. The gonad is single and median, lying over the gut in the first two thoracic segments. The ducts are paired and the female has a large and much-branched uterus. The genital somite where the ducts open is a fused one, representing the last thoracic and first abdominal.

According to Pratt there are over 6000, species of copepods, making this a very large Order. The majority are marine and they form the chief component of the macroplankton both in fresh and salt waters. Their great importance lies in their prodigious fecundity and vast numbers, providing a principal item in the menu of fishes. All young fish eat copepods and some, as the mackerel and herring, continue to do so throughout life. Thus, paraphrasing the well-known biological dictum that "all fish are diatoms," it may be said with equal force that all fish are copepods, meaning that their bodies are built from this ubiquitous source of nourishment. If you enjoy eating fish it may well be that some of the atoms of the molecules of a protein knocking around in your pancreas once played their role in the 17th segment of the first antenna on the left side of a cyclops, and before that graced the nucleus of a diatom. This is the story of the "transmigration" of food, or food chains, as explored by modern biological research.

A most surprising additional fact is that certain whales even subsist largely on copepods. It is said, quoting Taylor, that a single female cyclops would produce four and one-quarter millions of young in a single year, if undisturbed. Such powers of reproduction are probably very ancient, if we are to judge by the immense numbers of fossilized copepods in some of the coal-age shales. Copepods may actually darken the water of pond or lake, while in the sea they have been noted as coloring the water red for a wide area several miles in length. Many copepods are parasitic, infesting all of the food fishes and, when numerous, inflicting serious damage. Thus they turn the tables on the fish world.

Pratt recognizes eight suborders, one being the Cyclopoida. Characters of the body and appendages are of chief value in separating these suborders, and in the Cyclopoida the first antennae are not longer than the body and have not more than 17 segments, the second antennae are uniramous (or uniramose), that is, with one branch, the first four pairs of legs are biramous, the fifth uniramous. Females carry their eggs in *orisacs* (egg-packets) attached to the lateral surface of the genital segment on each side. The metasome is much wider than the urosome. The animals are free-swimming and occur at all depths in fresh, brackish, and salt waters, and a few are even found in wet sand and mud. There are 10 families with over 125 genera.

The Family Cyclopidae formerly contained the single genus, *Cyclops*, but others are now recognized, as *Mesocyclops*, *Macrocyclops*, *Eucyclops*, and *Ectocyclops*. In the typical genus, *Cyclops*, the second antennae are four-segmented, the first four pairs of legs are three-segmented and the fifth pair two-segmented, the second with a bristle and a spine. Over forty species occur, according to Garnett (*Freshwater Microscopy*), but the best known is *C. viridis*, the Green Cyclops. In size, specimens range from 1.5 to 5 mm, females being large enough to distinguish with the naked eye. The color is variable, but usually greenish. The first antennae are short, scarcely reaching to the rear of the head. This species will usually be found in any copepod collection from ponds and lakes in either America or Europe.

The beginner may have trouble locating this form in the field, but where they are abundant he will note a darkish cloud of minute creatures swimming slowly along in the water, the individuals moving with slow, jerky, erratic darts as they stroke with their first antennas. They have another method of progression, a swifter and more orderly propulsion with the swimming legs. Another feature that is certain to attract notice on close inspection is the single median eye, from which the name of the genus is derived, dark to bright red and often sparkling like a jewel.

Collecting is done with a Birge net or plankton net, concentrating the catch within a small jar. Whole mounts on microslides are not difficult; acceptable preparations can be done in balsam, better ones in glycerin-jelly. Routine methods of fixing and staining may be used, though many prefer unstained

2. Nauplius of Artemia, 240X.

mounts. Specimens should be narcotized in the killing process so that they will be relaxed and with appendages extended, allowing for positioning on the slide. Gray washes his living animals well in changes of water in a small bowl, ridding them of adhering plant material, then sprinkles a few drops of chloroform on the water. The animals will soon drop to the bottom, when they are picked out, spread on a slide in suitable positions, then treated with 95% alcohol to stiffen. Preferred stains, if any are used, are borax carmine, Mayer's paracarmine (either formula), fast green, iodine.

The male cyclops is not as pear-shaped as the female, being not as broad through the cephalothorax. The antennules are shorter and bent at right-angles to form claspers used in reproduction, giving them a slight resemblance to Lilliputian scorpions. Cyclops eats microscopic plants and animals captured while swimming, or browses on decomposing aquatic vegetation, and for this reason they are excellent scavengers in aquaria, not only keeping the precincts clean, but also serving as food for higher animals. Females lay summer eggs that hatch quickly, then later the winter eggs that tide the species over the adverse cold months. As the eggs are laid they are cemented into a packet that hangs from the opening of the oviduct, on the genital segment. As many as 200 eggs are carried by a single female, according to Palmer, and the complete life cycle takes but seven days.

The eggs hatch in a form termed the *nauplius larva*. Pictured herewith is the nauplius of *Artemia*, the brine shrimp, another type of microcrustacean:—these nauplii are so similar that any of them will serve to exemplify this stage of life. In cyclops the nauplius is shaped like an electric-light bulb, the broad end foremost. There is a median eye, and a pair of so-called "frontal organs" that are supposed to be sensory. No body divisions are present as yet, and only three pairs of appendages, the two antennae and the mandibles. At this stage, all of these are used for swimming and resemble the primitive type of swimming feet and do not at all look like the adult estate they will later assume. After a series of molts the fourth pair of appendages, the maxillae, put in their appearance, then comes the *metanauplius* stage, adding three more pairs, the maxillipeds and first two pairs of swimming legs. Finally there is the *cyclops* stage, with its division of cephalothorax and abdomen, the third and fourth swimming feet added in rudimentary form, and the antennae beginning to look more like their adult condition.

Now, ever since the time of Darwin, great interest has attached to these minute larval creatures and their successive stadia of development. Fritz Müller, dubbed by the historian Nordenskiöld as "one of the more peculiar representatives of biology during last century," went out to Brazil as a merchant, and there made his investigations and wrote a celebrated little treatise, *Für Darwin* (1864), in which occurs the first evolutionary account of recapitulation in the crustacea. The presence of the nauplius larval stage in cyclops, for example,

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is interpreted to indicate that an earlier ancestral form was an *adult* animal of the nauplius type. Some of the descendants of these adult nauplius-like creatures, gradually evolved the metanauplius form and these in turn gave way to the cyclops stage. This is as far as cyclops goes;—this is the situation at which cyclops gets off the evolutionary bus. Today each cyclops climbs his own family tree or recapitulates the stages through which he has evolved through the millenia.

The nauplius larva is to be found in some members of every Order of the Crustacea, hence it is taken to be the ancestral form of all. Also in every Order one or more shortcuts are made in at least some of the species, the nauplius occurring only as an embryonic stage, if at all, the animal hatching as a metanauplius, a cyclops, or the later *zoaea* stage, or even as one that is almost adult in appearance. Crabs, for example, pass through the nauplius stage in the embryo and hatch as a zoaea, then go on into a *megalops* stage before attaining the body form of a bona fide crab. You wouldn't recognize the freshly-hatched lobster,—unless you knew something about crustacean larvae. Parasitic forms, especially, curtail the ancestral picture, some of them hatching in the cyclops stage.

Certain copepods carry two egg-sacs, as in cyclops, while in other genera, as the handsome *Diaptomus*, there is a single median egg-packet, and in a few forms the eggs are laid directly into the water.

Turning to an entirely different aspect of cyclops study, the ecologist can tell us a great deal of interest about this and related organisms. Odom, for instance, describes the "blooms" of the zooplankton (the aggregate of minute surface animals) that correspond with similar blooms (rapid numerical increase) of the phytoplankton (the minute surface plants) in ponds and lakes. All the crustacea involved are "strainers," filtering bacteria and phytoplanktoners by means of combs of setae on their thoracic appendages. Thus, states Odum, these organisms, like cyclops, "graze" the plants as cattle graze vegetation, and plants and animals fluctuate together.

Tracing the history of the group, ecologists find that freshwater copepods have descended from marine forms. In our American lakes, where many investigations about them have been carried on, some species are found to be *littoral* (shoreline) in distribution, others *limnetic* (open water) and either *pelagic* (surface) or *abyssal* (deep water). Different species have a characteristic distribution that generally involves a vertical migration with the seasons. Littoral forms tend to be short, stout, and protectively colored in dark hues or green; limnetic species are long, slender, and colorless; these conditions being obviously adaptive. Some species appear only in temporary pools in the spring and are unknown at other seasons. Some species produce two forms, a winter and a summer type. The controlling distributional factor is unquestionably temperature, with each species having its preferences, and these may differ throughout the several life-cycle stages; conditions suitable for the nauplius may not necessarily prove optimal for the adult.

Studies of this sort are not only intriguing as excursions in pure science;—they have also their practical considerations. We have mentioned the vast positive importance of cyclops and allies as fish food, but the parasitologist can tell us of another aspect of our one-eyed fairy shrimp that is negative and detrimental to human interests. In the primitive *Diphyllobothrium latum*, the Broad or Fish Tapeworm of Man, the larva invades a cyclops as its first host. If the crustacean is then eaten by a freshwater fish, the cyclops is digested, but the parasite is set free in the fish's stomach. It penetrates the wall, wanders through the body cavity into the flesh, and there remains alive for a limited time. Larger fishes probably acquire infection from eating smaller, plankton-feeding fish. If man eats an infected raw fish, a customary item of the menu in the Orient, the larval tapeworm becomes adult in the human intestine.

Another member of this group reaches man through the mediation of cyclops. *Diphyllobothrium mansoni* produces larvae that infect the crustacean. If now a frog or snake, bird or mammal, ingests such a cyclops in drinking, it will acquire the larva, termed a *sparganum*. Dogs and cats obtain this form by eating the secondary host, and presumably man can acquire the sparganum in this manner also. However, the only established method of transference to man is by the use of the body of an infected animal as a wound poultice. Man does not harbor the mature tapeworm of this species,—but the sparganosis is bad enough.

A commoner and more serious affliction is that described by Moses (Numbers, XXI) as the "fiery serpent," known today as the Guinea Worm, *Dracunculus medinensis*. The adult female is a very long and slender roundworm, up to four feet in length though but 1/25 inch in diameter, that burrows in the deep layer of human skin and in subcutaneous tissue. The male is said to be probably only about an inch long (Buchsbaum). The fertile female secretes material that brings on necrosis in the skin so that a surface ulcer appears, a crater-shaped depression with a hole in the center from which the worm exudes great numbers of living larvae when the host's skin contacts cold water. Thus natives bathing or laundering will contaminate the water. The nematode larva must find a cyclops to complete its life cycle and, penetrating the copepod, lodges in the body cavity. If man inadvertently drinks such a cyclops the infection starts anew. India, Arabia, Egypt, and Central Africa are countries in which cyclops thus passively and innocently becomes an enemy of mankind,—at least of those benighted persons who drink unboiled water.

Marsh gives a bit of history of our knowledge of copepods. First mention of the group was by Stephen Blankaart in 1688, and next came the Danish zoologist, O. F. Müller with the first scientific descriptions in 1785. In 1820 Jurine published a natural history of the *monocles*, as the French dub cyclops, and in 1850 came Baird's *Natural History of the British Entomostraca*. Exact work was initiated in a series of papers by Claus a few years later, and the pioneer works of importance in America were by S. A. Forbes.

In classical mythology, a cyclops was one of a race of giants having but one eye, in the middle of the forehead at the base of the nose. These Kyklopes (preferred spelling) were the offspring of Uranus (Heaven) and Gaea (Earth) and were titanic beings who worked for Hephaestos (Vulcan) and helped him forge the thunderbolts of Zeus. They lived in the heart of burning mountains, especially Mt. Etna. One of them was Brontes, with his thunder (cf. *Brontosaurus*, the "thunder lizard", a dinosaur) and another was Steropes, with his lightning (a star, one of the Pleiades), but the most celebrated was Polyphemos (zool., a genus of moths) who imprisoned Odysseus and his companions, as related in Homer's Odyssey, in a cave. The giant ate two of them every day until Odysseus blinded his one eye. To escape, each man strapped himself beneath a sheep. Polyphemos felt each fleece as the sheep left the cave for pasture, but failed to detect the men.

There is usually some physical basis for myths, and it is possible that a legend of such monsters arose after old midwives' tales of the human fetal monster called cyclops, the newborn child having but a single eye (cyclopia) with a proboscis-like nose located just above it.

Our small cyclopean copepod cannot compete with either the monstrous infant or the mythological giants in size, but he makes up by his vast numbers and real contributions to many of the divisions of biological science.

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Follicle Song

(*Harrigan*)

F - O - double L - I
C - L - E spells FOLLICLE.
De Graaf it was who told us all about one,
Nary a hair can get along without one.
F - O - double L - I
C - L - E, lymphoid;
On a shoot it's a fruit,
In your neck it's a rooty-tootin'
FOLLICLE, thyroid!

in this moment

The prayer lingers still . . . across the table as Dad begins to serve . . . it brushes Mother's still-bowed head . . . it caresses Sally's fist as she reaches for the promised drumstick. The words of thanksgiving are being made real in this moment – the words of gratitude from a good provider to the Great Provider.

This time of security together is precious beyond all words.

The most precious gift we give or receive is the gift of security. It is the lifeblood of happiness. And only in a land like ours are we free to choose security as a goal of living.

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